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East Europe Report

SCIENTIFIC AFFAIRS

No. 712

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[Article by Moscow correspondent Dimitur Gornenski: "Prestigious Place in the 'Space Club'"]

[Text] Andrey Kapitsa, USSR Academy of Sciences corresponding member, on the significance of the new joint Soviet-Bulgarian experiment.

Moscow, 12 July

Once again we feel the dizzying altitude of the heights reached by contemporary Bulgaria in the course of its socialist development. The latest "Meteor-Priroda" artificial satellite is using even more advanced apparatus for the observation and study of the atmosphere and the surface of the earth, prepared by Soviet and Bulgarian scientific centers. This success of our scientists working in space research confirms even further Bulgaria's prestigious position among countries who have reasons to consider themselves permanent and active members of the "space club."

The new artificial satellite is part of the "Meteor" system which is a structural component of the 1967 Soviet space program and which, subsequently, became one of the areas of joint work with the fraternal socialist countries within the framework of the Interkosmos program. This system is also of great importance in terms of the progress achieved in a number of basic sciences. Nevertheless, its most distinguishing feature is the most tremendous role it plays in the solution of applied problems, above all in serving agriculture and other material production sectors. The artificial satellites in orbit, launched with Soviet rockets, are today the indirect and direct assistants of meteorologists, geodesysts, geologists, foresters and many other specialists who are feeling ever more tangibly the help which comes from outer space, and agronomists and agrobiologists and environmental protection specialists.

The launching of the new satellite is a proper occasion for presenting the view of one of the noted Soviet scientists in the area of space research. In the course of our talk Andrey Kapitsa, corresponding member of the USSR Academy of Sciences, emphasized that, by broadening the study of the universe, outer space science is increasingly meeting practical human requirements. Today, he stressed, literally all economic sectors are using most extensively data coming from outer space. Discussing in particular the system which includes the "Meteor-Nature" artificial satellites, he emphasized the following:

"Other space equipment used for the observation of the earth's surface is, essentially, a flying laboratory equipped with photographic and television systems, lasers and radar. With their help we determine the intensity of the earth's and the reflected radiation from the earth's surface in the visible and the infrared zones of the spectrum and within the radio range. Combined, these means make it possible to observe everything which can be distinguished by the eyes of man and a large percentage of that which is invisible to the human eye. Thus, for example, photographs received in the infrared range clearly indicate centers of destruction of various crops caused by pests. Normal crops are clearly distinguished from those threatened with drought.

In the case of clouds no observation is possible in the visible and infrared areas of the spectrum. In the radio range, however, the earth's surface can be studied from outer space regardless of weather conditions or time of day. Radio waves enable us to obtain exhaustive data on soil humidity. All this is only a small part of the useful services performed by the Meteor-Nature satellites. Let us add to this a variety of other information. The data reaching earth from such satellites make it possible to look at the condition of the ice cover and the snow lines, to assess the water resources and to determine precisely the area of ground heated by the sun. The image clearly shows centers of fires in mountain areas. This facilitates the efforts to put them out by the forest services.

By using observations in the various parts of the spectrum, compared with other methods used by plant protection stations, we can obtain data on diseases affecting crops and plants ten to 12 days earlier and take effective measures. The economic benefits of such a faster plant protection is tremendous, bearing in mind that due to diseases and pests 25 to 30 percent of the harvest perishes.

Many other examples could be added. The use of space methods in agriculture offers tremendous possibilities. The economic result of the utilization of space information in the next few years over Soviet territory alone may total billions of rubles.

The opinion of this great scientist is quite indicative of the success in this specific area of space research described in the announcement on the launching of the latest satellite in the Meteor-Nature series. What makes this even more pleasurable is that it represents the latest significant step in the development and intensification of cooperation and joint work between our scientists and their Soviet colleagues--the representatives of the country which inaugurated the space era of mankind and is, to this day, a first-rate power in the development and study of outer space for peaceful purposes, a country which is also assisting the development of space research in many other countries, the fraternal socialist countries first of all.

5003
CSO: 2202/15

ADDITIONAL INFORMATION ON REQUIREMENT USED IN 'METEOR-PRIRODA' SATELLITE

Sofia RABOTNICHESKO DELO in Bulgarian 15 Jul 81 p 4

[Article by Corresponding Member Prof Dr Kiril Serafimov, science observor for RABOTNICHESKO DELO: "New Space Accomplishment, Result of Soviet-Bulgarian Cooperation"]

[Text] The new satellite "Meteor-Priroda" was launched in the USSR on 10 July. Its purpose will be to resolve a number of scientific, methodical, technical and applied problems related to the telemetric sounding of the earth. Aboard the satellite, along with a scanning television camera, experimental three-channel microwave radio meter and service systems (for guidance, stabilization, data, transmission and reception of commands, energy storage and others) developed in the Soviet Union, a multi-channel spectrometer, single-channel microwave radio meter and computer system for the recording and preliminary processing of data, designed, developed and manufactured in Bulgaria, have been installed.

This joint fraternal space flight marks the beginning of the final stage of the "Bulgaria-1300" long-term comprehensive target space project. Initiated in 1976, as an interesting idea of a handful of enthusiastic people, this project met with the energetic support of the Interkosmos Council and, particularly, its unforgettable first chairman, Academician B. N. Petrov. It was based on a number of original ideas and rational plans for their implementation, major topical and important scientific objectives, and opportunities for the solution of progressive technical problems and for their multiplied utilization in practical work.

As always, the party and the government wisely assessed the excellent opportunities offered to our science and technology in taking a major step forward in inaccessible yet important and leading directions of contemporary knowledge and technical progress. The "Bulgaria-1300" space project was approved in 1977. Accordingly, this year two satellites will be launched into orbit. The first will be in accordance with the Soviet "meteor-nature" national program; the second (which will be launched in the near future) will be based on the Interkosmos program and will carry the name of the great 1300th anniversary of the founding of our state--"Bulgaria-1300."

The first project is already a fact. Every day it has one or two transmissions broadcasting data as it passes over our country's territory. The Soviet receiving

centers are obtaining from it a real flood of space information. As was announced, the purpose of the satellite is to resolve scientific and technical problems and obtain applied data as a result of the telemetric sounding of our planet. However amazing it might seem, over the past 15 years we have determined that a number of geomorphological data and geological and hydrological characteristics may be determined more accurately from outer space and that new ground resources may be found more effectively. At the same time, space methods in the areas of geophysics, geodesy, cartography, geography, oceanography, ecology, plant cultivation and other important areas were developed. This new joint satellite serves precisely the development of the earth sciences and the solution of a number of national economic problems.

Our systems and apparatus installed aboard this modern outer space system enjoy a number of advantages compared with all other apparatus used so far for this purpose. Let us emphasize, first of all, the exceptionally original new principle applied in the 32-channel SMP-32 spectrometer, which uses a light-sensitive photolinear element developed on the basis of semiconducters. This represents a new and even more advanced application of the original principle used in that world-famous Bulgarian Spektur-15 manual spectrophotometer which has been doing successful work aboard the Salyut-6 orbital station for almost two years.

The efficient technical implementation of this principle, the modern elements used and the original circuit solutions make the SMP-32 unquestionably the best multiple-channel spectrometer so far used in outer space (let us point out for comparison's sake that four- and six-channel equipment has been used aboard other satellites for purposes of telemetric sounding). The relatively low resolution capacity of our spectrometer is successfully compensated by the great advantages offered by the numerous optical and infrared channels which make it possible to use qualitatively new methods in the applied interpretation of data. Thus, our equipment is very suitable for global planetary studies and for the solution of big national economic problems covering vast territories of continents and oceans.

The single-channel microwave radiometer is a first step taken by our electronic industry in the creation of space radioengineering super-high-frequency equipment in the centimeter range. Its record-setting sensitivity will make it possible to determine the radioemission circumstances and the related heat fields and water reserves over considerable areas on earth. Its successful functioning is encouraging us to undertake new technical efforts in the field of super-high frequencies which are already finding ever more extensive applications.

Now, as we are preparing to engage in the intellectualization of the production process, the original ship electronic computer system for the recording and preliminary processing of data obtained with the help of Soviet and Bulgarian scientific and study instruments enjoys a deserved interest. The system makes possible the dynamic and adaptable control of instruments and systems. It ties standard telemetry to the exceptional requirements of the transmission of a tremendous amount of information.

Let us particularly emphasize that this is the first time comprehensive control-testing equipment with a microprocessor system and programmed control was developed, to guide the testing process and allow a certain diagnosing of eventual sources of deviation from normal operations. Since this comes closer to the problem of the

reliability of our space development, let us emphasize that exceptional measures were taken in the case of the meteor-nature satellite to ensure the automatic switching of reserve assemblies and systems and to guarantee their proper and lasting work.

I am aware of all the difficulties experienced by the collective of the Central Space Research Laboratory, which created these advanced space systems and instruments. The endless and restless efforts, exceptional enthusiasm, skill, daring and inventiveness of the group yielded pleasing results. Together with the immediate developers of such technical equipment, involved in this great exploit are hundreds of Bulgarian engineers, technicians and workers, mainly of the Ministry of Machine Building and Electronics. Good organization which involves many new and original elements of dynamic management made the timely and qualitative completion of this responsible part of the "Bulgaria-1300" project possible.

Now many new problems face the managements of the Bulgarian Academy of Sciences, Ministry of Metallurgy and Mineral Resources, the National Agroindustrial Union, the Committee for the Protection of the Environment, the Main Geodesy and Cartography Administration and many other Bulgarian departmental institutes, in terms of the optimal utilization, both at home and abroad, of the flow of space data received. It is also time to surmount the considerable difficulties which exist in the receiving and primary processing of information from space and in preparation for its comprehensive and purposeful interpretation. Our science and technology will use ever more extensively the outer space facilities as an incentive for modern development, and the new major success achieved in space will unquestionably encourage all of our creative workers in the struggle for the scientific and technical, economic and all-round progress of the homeland!

5003
CSO: 2202/16

ADDITIONAL COMMENTS ON 'METEOR-PRIRODA' SATELLITE

Sofia VECHERNI NOVINI in Bulgarian 18 Jul 81 p 6

[Statements by scientists from the Central Laboratory for Space Research (TsLKI) of the BAN [Bulgarian Academy of Sciences]: "The Bulgaria 1300-II in Flight"]

[Text] The latest joint development by Bulgarian and Soviet scientists in the area of the study and utilization of outer space for peaceful purposes is under way. "Meteor-Priroda" satellite is in flight. Along with instruments developed in the Soviet Union, a complex set of Bulgarian apparatus are registering data in outer space. The nature of the new representatives of our domestic space instrument manufacturing is described by scientific associates from the Central Laboratory for Space Research (TsLKI) of the BAN.

Professor Dimitur Mishev:

Telemetric studies of the earth from outer space are one of the most tempestuously developing directions in space research, in which Bulgarian scientists and specialists have been traditionally engaged and have achieved definite successes and earned recognition both at home and abroad.

After the development of instrument systems for comprehensive quasisynchronous measurements, after the essential and scientifically and practically important program for research and experimentation, prepared for the flight of G. Ivanov, the first Bulgarian cosmonaut, and after the unique multiple-channel"Spektur 15 M" spectrometric system and "Spektur 15 MS", its airborne variant, we are now witnessing a new display of Bulgarian science and technology in outer space. Bulgarian and Soviet scientists are engaged in joint development in the field of research and utilization of outer space for peaceful purposes. The "Bulgaria 1300-II" set of scientific equipment, developed on the basis of the "Bulgaria 1300" plan, is in flight. We can firmly state that it is the first time that such a complex and significant set of instruments for the study of own and reflected radiation from various natural formations and the atmosphere, in the visible immediate infrared and super-high-frequency range of the electromagnetic spectrum is flying in outer space. The entire set is controlled by a computer microprocessor system mounted aboard the satellite with active functional reserve and preliminary data processing aboard the satellite.

Also mounted on the satellite is a 32-channel spectrometric system for the study of reflected and own radiation in the visible and close-infrared range. The radiation of natural formations themselves is recorded in four different super-high-frequency wavelengths. The single-channel radiometric system was developed by Bulgarian scientists, while the tri-channel system was developed by Soviet scientists.

Huge data flows are reaching the receiving centers in Bulgaria and the USSR.

Important scientific and applied problems will be resolved following the interpretation of the multiple-spectrum data and images, such as the mapping of geospectrometric charts of the territories under study, the analysis of spectral images of different natural formations and phenomena and their dynamics, the drafting of catalogs of optical characteristics (spectral, optical and radiational) of various objects, in accordance with their seasonal variations, the determination of the full amount of water contained in the atmosphere and many others.

Scientific Associate Anton Stoimenov:

The modern instrument sets used for the telemetric study of the earth gather and transmit to ground stations huge amounts of data. A single communication involving the set of Bulgarian scientific equipment installed aboard the "Meteor-Priroda" satellite alone provides several million data bits. The great potential which our country has acquired over almost two decades of intensive development of computer technology is at the root of our success. The output of the IZOT DSO [State Economic Trust] and, above all, the OZZU [Consolidated Memory Systems Plants] in Plovdiv and the Elektronika Plant in Sofia, and the cadres trained at the Institute for Computer Technology, together with the specialists from the Central Laboratory for Space Research, made the designing and organization of a modern Center for the Reception, Recording and Primary Processing of Data from the "Bulgaria 1300-II" project possible within an exceptionally short time.

At the present time one stage of the scientific line of "Telemetric Methods" of the TsLKI of the BAN is fully operative. About 15 minutes after the latest communication with our computer aboard the "Meteor-Priroda" ISZ [Artificial Earth Satellite] the Primary Processing Center begins to receive data recorded on a machine-compatible tape. In a few minutes the computer releases the first printout showing an assessment of the conditions governing the reception and breakdown of eventual disturbances within the channel connecting the ground with the satellite. This marks the beginning of the process of automatic data synchronizing and decoding. Urgent information is provided on the condition and work system of the entire set of apparatus on the satellite. Metaphorically speaking, we begin by feeling the "pulsebeat" of the satellite equipment. This is followed by a quick assessment of the essential information provided by each of the scientific instruments--the 32-channel spectrometer and the radiometers. The initial coded information on the condition of the instruments is exchanged with the Soviet colleagues.

In its dialog with the operator on duty the primary processing system expands the entire volume of data, projects and provides the geographic coordinates of the studied target on earth and of the position of the sun for each ten km of track. Before the beginning of the subsequent communication the recorded data have been prepared for the study and interpretation by all consumers--scientists dealing with earth sciences, the atmosphere and the protection of the environment, with the help of computers.

Scientific associate Doyno Petkov:

The current generation of satellite systems for the study of space around the earth is a complex set of scientific instruments. Systems control and primary processing of data obtained from the satellite is accomplished with the help of computers mounted aboard the satellite.

The task in designing the set of "Bulgaria 1300-II" scientific instruments, mounted aboard the "Meteor-Priroda" satellite, was to develop a computer set mounted inside the satellite which would control and plan scientific experiments automatically. Such a computer complex was created on the basis of the Bulgarian SM 600 microprocessor family. The main position in the structure of the computer complex is held by the microcomputer aboard the satellite. It provides the communication and the synchronization of the comprehensive scientific equipment with the satellite systems. It processes the commands issued from the ground and establishes the necessary operational systems of the complex. The information flow received from the scientific systems is processed, expanded and sent along radio channels for communication with ground data processing centers. In addition to such basic tasks related to the processing of commands and controlling the information flow, other problems are resolved as well, such as the recording of data on digital tape recorders at each point of the orbit and their transmission at a convenient reception time on the ground; verification of scientific instruments; self-checking of assemblies and blocks within the system, and many others.

Greater reliability is a characteristic of the computer system aboard the satellite. All main units, such as the microcomputer, the operative memory, the digital tape recorder, the power sources, and others, for example, have backup systems so that should any one of the units break down the system can continue to operate.

Today, as the set of "Bulgaria 1300-II" scientific apparatus aboard the "Meteor-Priroda" satellite is flying in space and transmitting data using telemetric earth research methods, we can proudly say that the first Bulgarian airborne computer is operating in outer space normally.

Scientific Associate Boyko Tsenov:

The "Bulgaria 1300-II" set of scientific apparatus can operate in several basic regimens: direct data transmission, information storage and information retrieval. In a direct transmission mode data may be received on the ground only within the zone of radio visibility of reception centers in Bulgaria and the USSR. This is the most frequently used regimen, for the reception center in Bulgaria covers the country's entire territory and the data supplied by the satellites will be used mainly by Bulgarian scientists who are studying Bulgarian resources for a variety of economic purposes. The work program of the satellite was developed by specialists from the TsLKI at the BAN on the request of the information interpreters and users.

For the time being everything is working perfectly and the use of backup units has not been necessary.

Spas Delistoyanov:

The entire information received with the help of the instruments mounted within the set of "Bulgarian 1300-II" scientific equipment, located aboard the satellite, is transmitted along a digital radiotelemetric channel operating at frequency 137 mega-Hz. Our reception center is essential to the experiment. This called for the establishment of an exceptionally reliable system for reception and reporting. The TsLKI of the BAN developed a number of specialized electronic systems for receiving, synchronizing, recording and controlling data. Soviet specialists, who took part in the tests conducted by our reception center, immediately preceding the launching of the satellite into orbit, gave high marks to the quality of the entire reception complex.

In practical terms, how are the data received? The moment the satellite enters the radiovisibility zone of our reception center, the signals broadcast from the satellite are received by the ground directional tracing antenna. The data are received in a specialized system which synchronizes and restores the digital flow.

The restored digital flow is recorded on the SM 5300 Bulgarian-made digital tape recorder with a specialized recording control system. The same recording is duplicated by an analog tape recorder which records the signal at the output of the receiver. Every day we receive from two to four communications depending on the program given the scientific complex. In each communication a flow of several million bits is recorded. This tremendous amount of valuable data is recorded on tape by the primary processing unit of the computer.

The "Bulgaria 1300-II" scientific complex has already made about 100 revolutions around the earth. Today we expect its daily appearance over our country with confidence. However, I shall never forget the tense three minutes the evening of 10 June, when everyone in the reception center knew that the satellite had "risen" on the southeast, watching it "blindly" with the help of the antenna and waiting for its programmed communication. At precisely 2,053 hours the equipment aboard the satellite was turned on and in the course of a few seconds, as we followed the work of the control equipment, our two years of intensive work and sleepless nights had been crowned with success.

5003
CSO: 2202/18

DEVELOPMENT, USE OF INDUSTRIAL ROBOTS DISCUSSED

Robots Currently in Production

East Berlin DIE WIRTSCHAFT in German Vol 36 No 6, Jun 81 p 21

[Unattributed article: "Industrial Robot Technology of Today"]

[Text] The 10th Party Congress has significantly raised the original targets for producing and using industrial robot technology. Its decisions start from the idea that this path should lead to a decisive contribution towards making the national economy more efficient, especially towards releasing personnel. The directive of the Party Congress, therefore, formulates the task: "For an all-round change of the engineering and technological level of production as a whole, the development, production, and application of industrial robots should be significantly speeded up, for the step-by-step automation of production processes, for releasing personnel, and for reducing monotonous and physically hard work that may be hazardous to health. During the period from 1981 to 1985, 40,000 - 45,000 industrial robots should be produced and deployed.

Because of their character and because of international experience, it is necessary to develop comprehensively the in-house construction of robots and handling units in the combines and enterprises. Central production capacities for industrial robots must be created in important branches of industry. For this purpose, electrical engineering and machine construction must create the necessary preconditions for furnishing the required deliveries, such as microelectronic controls, electrical and hydraulic drive elements, and mechanisms, at the required level." (Directive of the 10th Party Congress of the SED, Dietz Publishers, Berlin 1981, p. 41).

As an important exhibition concerning the intensification of the national economy recently made clear, industrial robot technology may not be regarded too narrowly. This term is currently understood to mean the totality of basic means which are used for the automatic handling of work pieces, tools, and materials, to automate main and auxiliary processes. Their main objective is to release personnel. Industrial robots have available one or more axes of motion. With respect to their positioning and working sequence, they are either permanently programmed or are freely programmable. A distinction is made between two major groups: process-flexible and process-specific industrial robot technology (compare table). Process-flexible industrial robot technology comprises point-, track-, or sensor-controlled units, which are flexible in use, up to universal applicability. These units have a freely programmable motional sequence along one or more axes and for track motions.

Process-specific industrial robot technology comprises units and devices for making more efficient and automating equipment and processes of all types. This category includes machine- and equipment-bound units and also process-bound technology. The latter includes units for making more efficient and for automating the most various branch-specific engineering tasks in the economic units. This can also involve stand-alone handling technology, such as is especially produced in in-house construction for improving the efficiency of the combines and enterprises.

A community of users organized by the Umformtechnik Combine provides an example of the deployment of process- and machine-bound industrial robot technology. For existing individual presses, various devices were built, based on the division of labor, in the course of improving efficiency. These devices include, among others, belt-advance devices, strip feeds, roll-on and roll-off devices and coilers, as well as unbatching devices. Six hundred presses are supposed to be equipped with this organized in-house construction. It was expected that 800 to 1000 employees will be released.

A step towards a more complicated industrial robot technology is the type series of flexibly useable, freely programmable industrial robots for loading tool machines. Three sizes are projected, with various useful masses and various designs. The handling masses for type IR1 are 5 to 10 kg, for type IR2 10 to 40 kg, and for type IR3 40 to 100 kg. These industrial robots are produced in stationary and mobile form. To this are added special designs for integrating the industrial robot into the machines or into machine systems. Preparation for actual use involves a complexity that should in no case be underestimated and that significantly affects the economic result. The research center of tool machine construction (9001 Karl-Marx Stadt, Karl-Marx Allee 4) can provide detailed information on how to approach this. Experience with such deployment was also published in the "Wirtschaft", No. 4/1981, pp. 5-10.

The industrial robot IR3 P is already being used as a mass-produced unit, as the joint product of the Zwickau Engineering College and the VEB Sachsenring Automobilwerke at Zwickau. The IR3 P is used to load tool machines and systems. The automobile plants in Zwickau are currently using a total of 14 different robots and 71 insertion units within the framework of complex solutions for improving efficiency. They are considered pace-setters in the deployment of robots. They confirm this judgement, with their goal of deploying at least another 250 robots and insertion units during the coming five years.

One result of the collaborative work between Robotron and Ilmenau Technical College is the freely-programmable industrial robot PHM 4. It is used to automate assembly and testing processes, especially in the production of writing and office equipment, as well as to fabricate electromechanical and electronic components and modules. Information concerning this type of robot can be obtained from the VEB Robotron Center for Research and Technology (8012 Dresden, Leningrad Str. 15).

The ZIS 995 module for welding robots was developed by the Central Institute for Welding Engineering of the GDR. It makes in-house production of welding robots and welding production lines possible for the enterprises. Economical solutions can be achieved in this fashion, which are amortized in two to three years. The control is a numerical point-line control, which can be completed with position

sensors for finding the seam. It can be used in all welding operations for arc welding and resistance welding. The Central Institute for Welding Engineering offers documents for the module for follow-up use, and provides counseling services (4300 Halle/Salle, Köthen Str. 33a).

The ZIM 60 is a robot which is produced in the Central Engineering Enterprise of Metallurgy. It is a joint venture of all the combines in the area of mining, metallurgy, and potash. It involves an electrically driven hinge robot, which is freely programmable along five axes. Its handling mass is 60 kg. It has already been employed as a loading robot for technical and transportation tasks.

A manipulator module for the modular construction of stationary and portable manipulators has been developed by the Vogtland Tool Machine Factory. These devices are used to load the tools of special machinery and conveyor lines of large-scale and mass production. The maximum work piece weight is 60 kp, the number of movable axes is five max. The manipulators are controlled through the freely programmable microelectronic PS 2000 control. The units are driven hydraulically. Information can be obtained from the VEB Tool Machine Factory Vogtland (99 Plauen, Schenkendorfer Str. 14).

The industrial robot IR 5-10 is used in several contexts by the Household Devices Combine, for handling processes with the freely programmable PS 2000 control (modular system in stationary construction, three electrically driven main axes and three hydraulically driven gripper axes, work piece weight up to 5 kg). Information is available from the VEB Engineering Enterprise for Efficiency (9010 Karl-Marx Stadt, Srassburg Strasse 3).

Purposeful and Economical

By 1985, 40,000 to 45,000 industrial robots will be produced and deployed in our economy. For many branches, this represents unusually high demand. Researchers, designers, engineers, and technical specialists will have to throw onto the scales all their knowledge and commitment and all their capabilities. The performance of those combines which do not belong among the central robot producers will also become a conspicuous standard. Everywhere, the search for suitable and economically effective solutions predominates more and more. International trends, as well as our own experience, indicate that it is not only technically demanding, universally useable industrial robots that are of importance, but, for a considerable number of applications, simple devices of handling technology will suffice. These are equipped with the necessary technical capabilities for their respective tasks, such as control technology, movable axes, sensors, etc. For the more complicated types of robot technology, it is also true that only those technical parameters should become practical reality that are actually needed for deployment purposes. Only in this way, can the desired results be achieved with comparatively low economic expenditure.

Indeed, this was one of the core ideas of the technical congress of the KDT (Chamber of Technology) and of the VEB Research, Development and Efficiency of Heavy Machinery and Installations in Magdeburg, concerning the development, production, and application of industrial robots. Industrialists and scientists made it clear that in no way should only technically "complete" industrial robots be our only objective.

Sometimes there are quite simple solutions even for complicated problems. The decisive point is to find precisely that solution which accomplishes the respective handling task in a technical and economic sense. The technological tasks here are unambiguously the central emphasis in the Central Institute for Welding Technology of the GDR. This determines the configuration of "tailor-made" welding robots from the module set. Precisely because of this tailor-made character, these robots can be produced and deployed economically. The analyses of Dresden Technical University show that many assembly tasks can be solved quite well with only two freely programmable axes, and thus simple controls can certainly be used. There also are examples where combines are working with simple sensors in applications where other combines are waiting for the sensor technology of the future.

With the 1982 draft plan, the combines are proposing conceptions for the use of microelectronics in which the strategies for robot technology occupy an important position. The universal industrial robots with at least five degrees of freedom and the simple robots deserve special attention. In every case, economy is the decisive factor. For this reason, handling devices and simple robots for improving the technology itself must be developed with priority in the near future and must be produced as in-house means for improving efficiency.

Recognition of the Environment

In research laboratories, robots are already accomplishing greater feats than their "colleagues" in industry. They climb stairs, run through labyrinths, react to spoken commands, or answer questions.

In many institutes in the world, technical people are working on imparting new capabilities to the robots: To recognize their environment and their own condition, to sense the presence, position, and quality of work pieces or tools, to measure lengths, traversed paths and forces, to estimate obstacles, and to evaluate tolerances. For robots to be able to sense such quantities, many highly sensitive sensors (measurement sensors) must be developed. Contacting (tactile) sensor systems are used for specifically directed, sensitive gripping. Here, the inside of the gripper hand is equipped with sensors which report what forces are involved in the gripping process and what is the position and shape of the gripped object. Non-contacting sensors react to physical effects, such as changes in electrical resistance, of inductances, and of capacitance. They also use sound waves or radiations. Optical sensor systems occupy a special position. Especially for industrial robots, such sensors are being investigated in many highly developed industrial nations.

At the Central Institute for Cybernetics and Information Processing of the Academy of Sciences of the GDR, there also has been built an experimental stand for image recognition for industrial robots. The recognition method and the device technology have been successfully tested for selected work pieces of machine construction and fine mechanics. The efforts of the near future in this area will be directed towards achieving a more reliable solution with less expense for industrial utilization. The objective is to transfer to robots the industrial assembly of certain work pieces.

The industrial robots of the next years will also be equipped with the capability of reacting "intelligently" to unforeseen situations. For this purpose, the robots will be able to store and to learn from experience. The techniques for recognition, for setting up optimum handling plans, and for making decisions will impart to these robots a certain measure of "intelligence".

Industrial Robot Technology

Process-Flexible Industrial Robot Technology		Process-Specific Industrial Robot Technology	
Industrial robot for loading - loading of tool machines and analogous technical applications - transport processes - stacking and unstacking	Technological industrial robots - assembly - coloration - welding - forging - guidance of tools and working objects - textile processes	Machine-bound handling technology (fixed component of technical equipment) - insertion work - withdrawal work - magazining - positioning - automatic trouble-shooting	Process-bound industrial robot technology (automatic handling technology for performing loading and technological processes) - loading - technological tasks

Center for Technological Development

East Berlin DIE WIRTSCHAFT in German Vol 36 No 4, Apr 81 pp 9-10

[Article by Heinz Zerressen, director for technology and rationalization, VEB 7 October Machine Tool Combine, East Berlin, and secretary, EPAG (Industrial Robot Development, Producer, and User Association): "Model Solutions for Important Individual Cases"]

[Text] The technological center for making more efficient the tool machine combine "7 October" has increasingly been developed into a center of efficiency policy. In close collaboration with the combine enterprises, it should analyze scientifically processes which prepare for production as well as the production process itself, in order to obtain new information concerning the effective collaboration of people, working means, and working objects, and thus to provide effective support to the enterprises.

The combine "7 October" is responsible for the production and deployment of industrial robots. In accord with this great responsibility, the technological center concentrates on preparing robot technology for technological deployment. Another point of emphasis is process and methods research with the objective of finding complex, highly effective solutions for improving efficiency according to the principle of "integrated production segments (IGFA)" and "integrated assembly (IMO)". Connected with this are technological research tasks for improving the efficiency of technological preparation for production by the use of EDP (electronic data

processing) as well as by the step-by-step construction of technological and design jobs.

The long term efficiency conception of our combine, for the period 1980 through 1990, consequently specifies the following concrete tasks:

1. Automation of the loading of the tool machines and analogous applications by using loading robots.

2. Unburdening and releasing personnel from difficult areas, and from areas that may be hazardous to health (sand blasting, trimming of castings, paint spraying, etc.), by using technological robots.

3. Complex improvements in the efficiency of transport and conveyance processes within the framework of integrated production by using robots of all categories and designs.

By our exertions in the area of technical research and preparation for the deployment of industrial robots, we were capable of making available the following materials to the enterprises of the "development, production and application community for industrial robots":

- Basic technical documents for the technical working plan and for the set-up of technological units;
- type projects for technical units with industrial robots;
- technological specifications for the equipment of technological units and production cells;
- plans for the design and implementation of working processes for the production of peripheral equipment of technological units with industrial robots;
- design documents for the peripheral equipment of technological units of industrial robots;
- uniform guidelines on "protection-quality requirements in the deployment of industrial robots" as a foundation for all initial applications;
- uniform execution plans for the preparation, implementation, start-up of technological units with industrial robots;
- basic documents of a technological deployment strategy for industrial robots (loading robots).

Figure caption: The lathe operator Rainer Wunderlich, from the tool machine combine "7 October" here programs the working steps of an industrial robot for the next two shifts. This robot simultaneously loads two NC machines. Besides programming and checking this technological unit, the highly trained lathe operator can also operate three processing machines.

First type project
DF 2 CNC 600 (Type WZM)
IR 2/S II - IRS 2000 (Type IR)
Two or three work piece memories for welding pieces.

Second type project
DS 2 CNC 600 (Type WZM)
IR 2/S II - IRS 2000 (Type IR)

Two or three work piece memories for chuck   pieces

Third type project
DS 2 CNC 600 (Type WZM)
IR 2/S II - IRS 2000 (Type IR)
Corrugation processing with two work piece memories

Fourth type project
DS 2 CNC 600 (Type WZM)
IR 2/S II - IRS 600 (Type IR)
Welding piece processing with integration of the measurement location

Fifth type project
DF 2 CNC 600 (Type WZM)
IR 2/S II - IRS 600 (Type IR)
Work piece processing and integration of the measurement location.

Work is being done on making these working documents more complete. On their basis, it is possible to prepare for use more effectively and to secure overall coordination of activities. By working out typical solutions, the objective of the national economy to obtain short-term and multivalent implementation of technological units with industrial robots is being met. In this way, it is possible to work out the technological, constructive, and technical performances only once, and to apply them with a little adaptation effort in the enterprises for the specific application. For the Berlin enterprises and combines of the development, production, and user community, as well as for the enterprises of our combine and other potential users, typical projects for the loading of lathes for the processing of chuck and center lathes in single and multimachine operation and various peripheral equipment have been or are being worked out within the framework of our research program in close collaboration with the coordination group of the EPAG (Development, Producers and User Association) and other institutions.

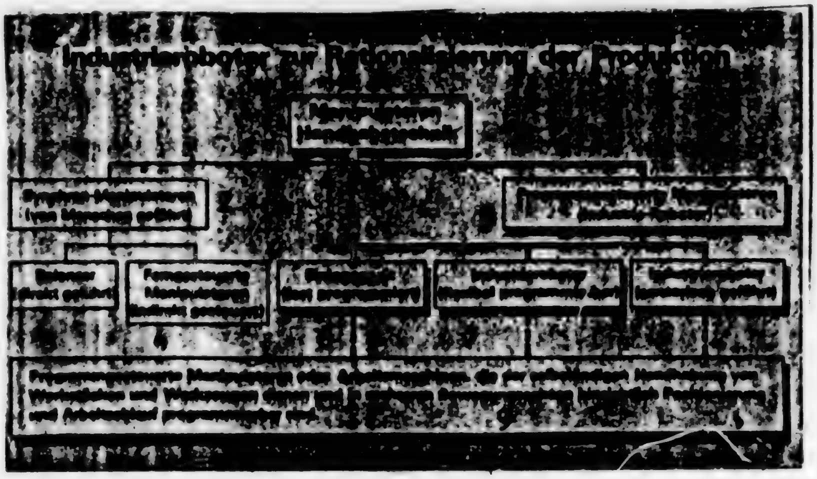
The typical projects are based on information that was obtained during the preparation and planning of technological units in the VEB Berlin Tool Machine Factory, Marzahn, in the VEB Lathe Plant, Leipzig, and in the VEB Combine "Fritz Heckert", Karl-Marx Stadt. Experience from specifically directed international collaboration with our fraternal socialist countries has also been taken into account. In agreement with the long term conception for product development and the conception for the further development of industrial robots, technical research will be concentrated more strongly towards enhancing the effects from the utilization of robot technology. In particular, the release of personnel is to be promoted in the design of typical projects by, among other factors, the following measures:

- Use of automated measurement site in the technological unit with industrial robots;
- implementation of a detection of work piece breakage with optical and/or acoustical indications;
- implementation of a machine-integrated measurement system to secure the finished processing of tool components;
- implementation of wear and compensation measurements and realignment of tools in combination with measurement controls;
- development of a diagnostic system in robot-equipped technological units for

applications in a third shift with only a few operators, on the basis of complex automated solutions.

These demanding objectives require a reinforcement and shaping of the technological potential and the build-up of a powerful experimental center in the central enterprise of our combine. Here, initial solutions and further developments in automation should be pursued from a technological perspective and should be tested in long term tests.

The most important tasks of the experimental center will consist in developing multivalent solutions for the highly productive use of industrial robots, starting from the international status in the area of robot engineering, and in close collaboration with socialist countries - for example, with the Peoples' Republic of Bulgaria, there already exist quite specific agreements.



Industrial Robots for Improving Production Efficiency

1 Manipulators, handling technology
2 synchronous manipulators (human guidance)
3 balancer (directly guided)
4 remotely controlled manipulators (indirectly controlled)
5 program-controlled manipulators (industrial robots)
6 insertion unit (fixed programming)
7 industrial robot (flexible programming)
8 industrial robots (guided by sensors)
9 Progam controlled manipulators or working machines, which are used for the independent handling of work pieces and tools and which can be programmed along several axes of motion as regards positioning and working sequence.

Robot Manufacturing Center

East Berlin DIE WIRTSCHAFT in German Vol 36 No 4, Apr 81 p 9

[Article by Fred Dellheim, plant director, VEB Berlin-Marzahn Machine Tool Factory: "Central Manufacture of Robots"]

[Text] As a consequence of the decisions of the Politburo of the SED Central Committee and of the Ministerial Council, upon directive of the Minister for Tools and Processing Machines, important tasks for the development and production of robot technology were entrusted, in mid-1979, to the Berlin Tool Machine Factory. These tasks comprise not only the undertaking of production on the basis of model-construction documentation by the Research Center of Tool Machine Construction, but we were also charged with the responsibility to develop industrial robots as well as to create production capacities for their production. The scope of the production of tool machines was not reduced thereby. The production of the first 20 industrial robots in the year 1980 proved to be an extraordinarily complicated task, which could not have been solved without close collaboration with several cooperation partners and with the central operation of the combine "Fritz Heckert". The latter, in parallel to ourselves, likewise produced 20 robots.

This task was all the more complicated since production was new not only for the final producers but also for all the cooperation partners. The available documentation could not fully correspond to the conditions of mass production. Both because of a lack of production capacities and also because of the necessarily short run-through times, many processes were necessary which involved a division of labor.

Besides the principal partners, such as the enterprises of the combines ORSTA-Hydraulics and the VEB Numerics "Karl Marx", the enterprises "John Scheer", Meuselwitz, and Mikromat Dresden from the "Fritz Heckert" combine and other cooperation partners participated in the project.

Building up a working organization in such a short time and the many problems that had to be mastered required two preconditions:

First of all, a deep understanding had to be developed for the significance to the national economy of the task entrusted to us, and an attitude for mastering these tasks in conformity to the party had to be created. Under the leadership of the party organization, quite extensive political-ideological work was performed in this connection. From the operating section of the Chamber of Technology, this task was effectively supported by lectures and other qualification measures.

Secondly, tight management of these processes was required in order to guarantee that all the directorates could manage their responsibilities in a coordinated fashion. The weekly conference of all responsible parties in the "robot" working staff of the enterprise director, under the leadership of the project manager, proved a necessary and effective measure.

It is understandable that such a complicated process could not run without friction and without contradictions within the enterprise and between the cooperation partners. But due to an open attitude conformable to the Party, the production tasks were solved successfully. With the delivery of the robots to the user enterprises and due to the close collaboration with the development, production, and user association in Berlin, the scientific and production association in Karl-Marx Stadt, an the enterprises in Magdeburg, Leipzig, and Dresden, all the preconditions were created for the initial applications and for the gathering of valuable experience in the deployment of robot technology.

Collaboration with the research center of tool machine construction in Karl-Marx Stadt during this period comprised not only scientific-technical questions for securing production during the year 1980. The research center accepted major responsibility for supporting, by means of programming typical applications, the preparations for deployment within the enterprises. But the main point was to draw conclusions from the production experience of the year 1980, to increase the effectiveness of robot deployment and to be able to produce, beginning in 1981, robots that can be flexibly deployed and freely programmed, in accord with the Politburo decision.

These tasks also demand significant development performances in the combine ORSTA-Hydraulics and in the VEB Numerics "Karl Marx". They also require thorough revision of the design documentation in our enterprise. It here proved good and necessary, in defending the individual developmental steps, if the other combines and enterprises participating in the cooperation chain, are present to each participating partner.

Up to now, we have succeeded quite well in coalescing various perspectives and requirements into optimal solutions. Of course, this required much consultation on the level of the enterprise directors and general directors. Consultations under the management of the Minister were also required. Now we are convinced that the lofty objectives of the 1981 plan will be mastered, although, with us for example, this implies tripling production at a significantly higher technical level.

Our task comprises the development of a construction series of loading robots of various sizes and shapes. Due to the high qualifications of many cadres and due to the intensive study of international experience and developmental trends, we have good preconditions for our own point of view and for a scientific difference of opinion concerning solutions that are effective and that are compatible with the international status. At a recent closed meeting, in which the partner enterprises and research institutions participated, a common point of view was worked out. After being confirmed by the Minister, this formed the foundation for further work.

This point of view, for example, anticipates corrections in the developmental sequence, corresponding to the partial assortment that will be handled in the first instance. It takes into account the trend towards increasing deployment of electrical drive technology, and it also includes aspects of closer coordination of the development work in the area of loading robots with the development work of other industrial areas for technological robots. Due to the collaboration of the Academy of Sciences, problems of the development of second and third

generation robots could be clarified.

An essential part of the responsibility of our enterprise consists in building up production capacities for robots while simultaneously increasing the production of tool machines. By efficiency measures we are using the available operating terrain to create the required production area for future years.

The capacities which will be newly built should not only be effective in securing the piece numbers anticipated by 1985 but, on the basis of more effective technologies, they should also make possible further increases. To secure investments that coincide with the development and transfer of robots, one needs high deployment readiness not only in our enterprise but in all the collectives that participate in planning and implementation, especially the principal contractor construction of the BMK (Building and Assembly Combine) Magdeburg. Optimum collaboration will be secured through biweekly reports to the investing agency.

The logical implementation of the task entrusted to us, of developing and producing loading robots, demands further steady efficiency increases of tool machine production and steady further development in agreement with the needs of the Republic with obligations towards socialist countries - especially the Soviet Union - and with requirements of exports into the NSW (non-Socialist monetary area). Our enterprise collective is fully addressing these tasks under the leadership of the party organization.

Production-User Association Organized

East Berlin DIE WIRTSCHAFT in German Vol 36 No 4, Apr 81 pp 5-6.

[Article by Wilhelm Frischmuth, general director, VEB 7 October Machine Tool Combine, East Berlin: "Cooperative Work Assures a Fast Pace"]

> [Text] The heads of the following combines, enterprises, and scientific establishments cooperate in the EPAG [Industrial Robot Development, Producer, and User Association]:
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> 7 October Machine Tool Combine, Berlin; Berlin-Marzahn Machine Tool Factory; Automation Facilities Construction Combine, Berlin; Rail Vehicle Construction Combine, Berlin; Karl Liebknecht Transformer Works; Berlin Metalworking and Semifinished Products Works; Berlin Automated Refrigeration Enterprise; Bergmann-Borsig; Central Engineering Enterprise for Metallurgy; Humboldt University of Berlin; GDR Academy of Sciences; Bruno Leuschner College for Economics; Wildau Engineering School; Lichtenberg Engineering School; Karl-Marx Stadt Machine Tool Construction Research Center; Berlin Bezirk Planning Commission.

For the 80's, an increase of output and a growth of effectiveness and quality are necessary. These results will be decisively determined by the success of accelerating science and technology and thereby guaranteeing a comprehensive advance of efficiency in the national economy. One important Party line is to achieve higher economic results from scientific progress by the broad application of robot technology.

The tool machine combine "7 October" Berlin was set the task of pursuing the development, transfer, and production of industrial robots in such a way that it becomes a co-determining factor in the international scientific-technical level in this area. Our combine was thus entrusted with a heavy responsibility in terms of the national economy. Fulfilling this responsibility, primarily requires the use, from the very beginning, of the advantages of our Socialist social order for achievement according to plan and directed towards proper objectives. Starting from the social significance of robot technology, as an essential component of technical innovations necessary to intensify production, and building on the basis of the decisions concerning "measures for the development, production, and deployment of industrial robots", which were promulgated in May 1979 by the Secretariat of the Central Committee of the SED by the Ministerial Council, we formed the EPAG in February 1980. Through this "Development, Production, and User Association for Industrial Robots", we wish to open up the great potencies of Socialist community work. Such a complex and complicated task required both clear political leadership and uniform and coordinated action beyond area boundaries, including the creative collaboration of scientists. Under the leadership of the General Director of the tool machine combine "7 October" Berlin, - and with the preservation of full individual responsibility of each partner for the solution of the tasks posed to him - the industrial enterprises of the capital, the supplier combines, representatives from the research center of tool machine construction, and scientific institutions in Berlin are consequently acting together. It is their task to manage the development, production, and deployment of industrial robots for the metal-processing industry of the capital. Already in its formation, the EPAG could lean on the progressive assistance of the District Management of the SED Berlin. In May 1980, the Secretariat provided a clear and specific orientation for the political leadership and for the management implementation of all those measures which have as their objective the accelerated development, production, and application of industrial robots.

In the battle programs of the Party organizations of all Berlin enterprises participating in the project, as well as in the letter of the tool machine constructors of the capital to the General Secretary of the Central Committee of the SED, Comrade Erich Honecker, of 2 June 1980, the requirements and obligations were made manifest, of mastering, in socialist competition, the necessary accelerated tempo in preparing and implementing production. Today, we can judge that the purposeful creative work of the employees, the high flexibility of management, and a constructive approach by all the partners have succeeded in successfully accomplishing the tasks. posed by the Sixth Congress of the District Management of the SED Berlin, for the political, economic, ideological, and organizational preparation for the Tenth Party Congress in the area of the production and deployment of industrial robots. Furthermore, the objective set by the decision of the 14th Conference of District Delegates, namely to put into operation eight deployment centers of industrial robots within the capitol by the 10th Party Congress of the SED, will also

implemented. The will be built in the central enterprise of the tool machine combine "7 October", in the VEB Bergmann-Borsig, in the VEB Berlin Brake Works, in the VEB Berlin Metallurgical and Semi-finished Goods Works, in the VEB Automatic Refrigeration, in the VEB Transformer Plant "Karl Liebnecht", and in the VEB Central Engineering Enterprise for Metallurgy. The Party project "Deployment of Industrial Robots" in the VEB BWF (Berlin Tool Machine Factory) Marzahn has already been implemented and is now being used as an experimental stand for testing the modules.

The coordination and cooperation of the work of the combines, enterprises, and scientific institutions by the EPAG has proven itself as a form of political and organizational leadership of such a technical innovation process which must be quickly implemented and which has a decisive character. A high performance contribution of the departments for increasing the efficiency of user enterprises as well as initial results from the deployment of industrial robots have been achieved in a very short time.

To prepare the building of deployment centers also included familiarizing the employees of the participating enterprises with the significance of this technology in the battle for higher output rises and to arouse their readiness for active collaboration.

The concepts of the party and enterprise management proved themselves here. These were directed towards an effective solution for the political-ideological and technical-organizational tasks. Thus, starting from the Party administration and carried forward by the comrades of the individual working areas, an atmosphere for mobilizing additional activities could be created everywhere. Stimulated by results which were constantly made visible, true Socialist efficiency collectives developed. Looking back on the one year's activity of the EPAG, it can be said that the high performance reached in 1980 and in the first quarter of 1981 was possible only because an attitude conformable to the party was always combined, in these implementation collectives, with the advantages of Socialist collaboration and mutual aid. Where responsible tasks were entrusted to youth, the Party principle of promoting and challenging youth was once again confirmed.

Because of the constant political-ideological work to form uncompromising attitudes, it became possible, with various suppliers, to overcome a lack of readiness to accept risk. Still another positive result of the collaboration within the EPAG should be mentioned here: the close Socialist collaborative work with scientific institutions. For example, the "Bruno Leichner" College for Economy developed the appropriate methodological foundations for the economy of robot utilization. A collective of 23 students is now verifying, in the deployment centers, the practical maturity of the existing methodological materials.

In the leadership organization of the community, a series of measures proved especially effective, for example the formation of a permanent coordination group consisting of representatives from the user enterprises, under the leadership of the Secretary of the EPAG. It could render effective assistance and support especially to those collectives for which the loading robots from the Marzahn Tool Machine Factory are intended, but which hitherto have had little or no experience with numerically controlled tool machines. For example, this concerns the VEB Berlin Metallurgical and Semi-finished Goods Plants as well as the Central Engineering

Enterprise for Metallurgy.

The periodic consultations of the enterprise directors of the participating enterprises, under the leadership of the General Director of the tool machine combine "7 October", as well as a regular exchange of information among the technical directors of the user enterprises have also proven themselves. These meetings made a significant contribution towards increasing the personal commitment of the managers, towards clarifying problems involving the division of labor, towards deciding basic questions, as well as towards solving particular technical problems. For example, by an efficient division of labor between the enterprises in the capital, it was possible to produce the required peripheral equipment for the industrial robots and to make them mutually available. This effective mode of procedure also is the basis for an increase of technical knowledge in all the enterprises and for the simultaneous formation of contacts between government and managers. In the future, too, these factors will contribute towards joint solutions of complicated problems.

Thus far, the implementation of the 1981 planning tasks in the area of industrial robots is again characterized by many initiatives from the employees of all participating enterprises. Starting from the decisions of the 14th Conference of District Delegates, these initiatives are directed towards the further worthy preparation of the Tenth Party Congress of the SED.

The 1981 industrial robots from the tool machine combine "7 October" Berlin especially must have significantly enhanced use characteristics. Characteristic features in this connection will be a new hydraulic drive technology as well as a multi-axis electronic control technology. These ambitious objectives generate the necessity of securing parallel development, testing, and mass production. The combine ORSTA-Hydraulics and the VEB Numerics "Karl Marx" likewise bear major responsibility for this.

In order to guarantee such synchronous operation, all forces of the Marzahn Tool Machine Factory were concentrated towards assuring, in conjunction with the Research Center of Tool Machine Construction, that the first 20 industrial robots were started up and at the same time their design was revised.

On the basis of the decisions of the 14th Conference of District Delegates, the further activity of the EPAG basically concentrates on still further applications of robot technology in the industry of the capital. Their effective use should significantly increase productivity, should lead to a savings in working forces, should eliminate monotonous and physically difficult activities as well as activities hazardous to health, and should improve the working conditions of the employees. This presupposes that, in every combine and in every enterprise, existing technologies as well as the production organization will be thoroughly analyzed and - building on this - rapid designs will be developed for the deployment of robots by the year 1985. The objective is to produce a savings of two to three employees for each industrial robot.

To provide effective support, even in this year, for the quicker and much broader utilization of robot technology in the enterprises of the capitol, the EPAG is collaborating in the completion of the district program on the basis of the conceptions of the combines and enterprises.

The tool machine combine "7 October" must develop complex solutions for automating small scale and medium scale assembly line production. In order to be able to implement this goal rapidly - in parallel to actual robot development - the technological efficiency center of the combine began to create type solutions for production cells.* Practical type solutions of technological units for corrugated and flanged work pieces already exist at the present time. In order to test out pilot solutions, we are setting up an experimental center for production cells in the central enterprise of the combine. In 1982, with its first expansion stage, it will create the preconditions for rapid transfer of these complex technological solutions.

Its development to an industrial robot technical center presupposes close collaboration with the Academy of Sciences of the GDR. This will secure an accelerated development of sensor-controlled (equipped with visual and tactile capabilities) industrial robots. Already in the first half of 1981, we want to establish the contractual relationships, so that not only testing and assembly line production of robots can be developed, but also complete production cells related to practice.

The development and design work will be implemented on time, and cooperation will take an effective shape in the introduction of more types of industrial robots by the combine "7 October". These factors will be decisive ones in deciding the time and the effectiveness for deploying robots in the capital. At the same time, we must continue to develop the tool machines that are intended for combination with industrial robots in such a fashion that the adaptation effort for the user drops significantly.

In order to achieve successfully and effectively the aim defined by the General Secretary of the Centrol Committee of the SED, Comrade Erich Honecker, in his concluding remarks at the 14th Conference of District Delegates, namely to deploy 1200 industrial robots as well as process-specific handling technology in the capitol by 1985, the Socialist community work must be carried forward at a still higher level on the basis of deployment conceptions and on the basis of the combines' and enterprises' own activities.

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*Production cells are spatially organizationally closed technological units, which consist of one or more automated tool machines, by means of which one or more component families can be processed completely or nearly completely in an arbitrary sequence of the production process, and which have a partly automated flow of work pieces to work piece depots before, in between, and afterwards, which is implemented by means of an industrial robot.

Experience in Robot Application

East Berlin DIE WIRTSCHAFT in German Vol 36 No 4, Apr 81 pp 6-9

[Article by the directors of various East Berlin enterprises (see source subheading below): "More Rapid E change of Experience Through Application Centers in Berlin Enterprises"]

[Excerpts] Dr. Heinz Brusch, Plant Director, VEB Bergmann-Borsig:

During the 1980's, our enterprise collective must also take new routes to utilize scientific-technical progress still faster and more comprehensively. Related to this idea also is the decision to create an application example in our enterprise for the use of industrial robots, in honor of the 10th Party Congress. Taking into account the available robot technology, we decided to organize the initial application in the small-mechanical production of the enterprise. A technological unit for the lathe work on shaft parts was designed, and this was equipped with an industrial robot of the type IR 2/S II.

In comparison with other enterprises of the EPAG, our plant has some special features. These are based on the handling and processing of turned shaft parts. The production cell that has been conceived as a type project is designed for processing chuck lathe parts. Starting from our production assortment, we are to decide for a different variant, which required some changes of the peripheral device technology.

In engine construction, numerous studs, dowel screws, and other bolt-like parts are needed both for the new construction of gas and steam turbines and also, to a considerable extent, for repair needs. These components previously have been predominantly produced on conventional lathes in small-mechanical production. However, in the case of our production, a decided piece-work fabrication was involved, and consequently the piece numbers and lot sizes of most components lie at the lower limit for effective fabrication modes and principles.

The production cell had to be adapted to these contingencies in order to achieve optimal efficiency. For this reason, the production cell includes, among other things, a center lathe type DS 2 CNC 600, an industrial robot type IR 2/S II - IR 2000 with a long-section gripper, two work piece storage units for shafts and two rotary column cranes for loading the work piece storage units.

The production cell was combined with an existing lathe DFS 400 NC to form a two-machine operating complex. A special feature relative to the chuck variant is the long-section gripper for shaft-shaped parts and the work piece storage unit for shafts with an hexagonal upper storage section.

By using the generally automated system, we achieve a saving of two jobs and consequently a relative release of four employees. Despite considerable investment costs, the increase of industrial goods production yields a recovery time of about three years.

At this time, a study is being worked out to determine the application possibilities for further robots. We are here concentrating on making several technical processes more efficient, for example, welding technology or sand blasting.

Figure caption: The VEB Bergmann-Borsig is the first one to perform lathe work on shaft parts. An IR 2/S II with long-section grippers loads a center lathe machine type DS 2 CNC 600. The shafts are prepared in two storage units (here in the model).

Manfred Friedrich, Plant Director, Karl Liebknecht VEB Transformer Plant:

We are using the industrial robot IR 2/S II, which the Marzahn Tool Machine Factory has integrated into a technological unit consisting of four NC machines. The industrial robot here functions as a loading robot for the NC machine DF 2 CNC with three work piece storage units. The entire machine complex is supposed to be operated by one employee per shift. We are therefore making a transition form a three-machine operating system to a four-machine operating system.

Many weeks and months of strenuous work have been mastered in the meantime, and there were numerous problems that had to be cleared along the way. The present status could only be achieved by the joint work between the enterprises of the EPAG and by the collective collaboration within the Youth Project. With high spirit, youth secured the practical implementation of the task, for example, the conversion of the machine to the four-machine complex ahead of schedule. Special emphasis was here placed on the qualifications of the employees. The operating organization of the KDT was particularly useful in this connection. The qualitative changes resulting from the handling technology imply higher information requirements for many colleagues. Operators, repair personnel, efficiency experts, technologists, and managers had to be trained in questions of the control, operation, programming, maintenance, and service, without thereby neglecting current operating tasks.

The technical documentation of this new technology was not always complete or was not available in all particulars. For this reason, improvisation was often necessary. The good collaboration within the EPAG and the actions of the coordination group made a valuable contribution here.

For our experience, however, it is necessary also to make some remarks concerning the peripheral equipment of the technological unit. Within the framework of the EPAG, our plant was assigned the task of undertaking the construction of the storage units for all the initial user enterprises. Unfortunately, the construction drawings that were provided us from the research center for tool machines could not be used for our application. This made it necessary for our efficiency department to develop a new solution for the storage units in a short time. The collective charged with this task did this in such exemplary fashion that the solution has in the meantime already been accepted as a patent. Within only two months, we could deliver the first storage units. The good collaboration and the division of work in building these peripheral units, between the VEB Refrigeration Berlin, the VEB Berlin Brake Plant, and our own plant deserves special mention here. An engineer of the Youth Object was here specially entrusted, for this task, with the leadership and coordination of the work required therefore. By the end of March 1981, 17 storage units could be made available to the initial users. This example

of a rapid solution of efficiency tasks indicates clearly, in our opinion, what power, what wealth of ideas, and what commitment can be aroused among the employees if the task is unambiguously defined and the objective is clear.

With the above-mentioned first application example in the TRO (Berlin-Oberschoeneweide Transformer Works), we have gathered experience for further application possibilities. This experience is already applied in the designs up to 1985. Thus, the next application, the "layering of core sheets" for transformers, is being prepared technically and technologically for 1982/1983.

But our enterprise must also increase the rate of utilization of industrial robots and handling technology, corresponding to the requirements of the eighties. The experiences of recent months are an important foundation for this.

Figure caption: The work piece storage unit in the peripheral equipment of the loading robot IR 2. A young collective in the efficiency department of TRO quickly developed this storage solution, was awarded a patent for it, and secured the timely start-up of the Berlin application centers.

Egon Pfeil, Plant Director, VEB Berlin Brake Plant:

In our enterprise, too, the introduction of new technology was never free of problems. But much experience exists in this area and the insight that the political-ideological work that has been done will be decisive factor for the success of deploying new technology. It was precisely a few negative examples that vividly illustrated this for us. Thus, for example, much time passed between the appearance of the first NC machines and their utilization in the Berlin Brake Plant. Especially from an economic perspective, there were many reservations among the engineers and many arguments against the use of NC machines. This changed only by thoroughgoing political-ideological work. In the meantime, a large number of NC machines are in operation, and, in virtue of good preparation, they could even be brought over into production in record time. The right faith moves mountains!

Based on these experiences, the first industrial robots were deployed in the VEB Berlin Brake Plant at a fast rate. This had several reasons. For instance, the participating colleagues could quickly be convinced of the necessity of solving this problem rapidly. But an especially important factor was that the enterprise was not an individual fighter for technical progress, but a member of a community consisting of enterprises with the same interests.

The initiatives in the territory and the actions of the Development, Production, and User Association led to our first industrial robot starting trial operation on the eve of the 10th SED Congress.

Our present estimate is as follows: This rapid development was good, because waiting helps noone. Only collaboration in mastering technical progress yields knowledge which pays off in the future. Besides the experience which we could gather for further applications, the first industrial robot also serves us as an aid for ideological work. This has already become effective in working out the deployment conception for industrial robots for the time period up to 1985. During the preparation for such deployment in scarcely a year, not everything went smoothly

and without friction. There had to be mutual explanations, the discouraged had to be encouraged, difficulties that initially appeared insurmountable had to be overcome. A large number of employees had to be integrated into the preparation process. What was so specially important about mastering these tasks? What had to be guaranteed was strong leadership by the government leaders, with the enterprise director at the head. The enterprise Party organization paid great attention to the deployment of industrial robots. Regular control consultations based on a procedural plan, the assumption of robot deployment into the Party-Congress projects of the enterprise, the letting of Party contracts and their regular accounting before the APO (Department Party Organization) leadership for engineering and in the Party groups, the formation an initiative brigade under the leadership of the officiating director for engineering, all these are measures which influenced the successful course of the project. On this basis, many employees exhibited great initiatives. Each participant gave his best.

The decisive factor for the success of this project also was the super-enterprise community work within the framework of the Development, Production and User Association for Industrial Robots.

Finally, our honest estimate is that the VEB Berlin Brake Plant could not have mastered these tasks alone in the relatively short time.

The first industrial robot in our plant is the type IR 2, which was coupled with a lathe machine DS 2 CNC 600. A chuck part was processed with an annual number of 70,000 units. This technological unit consists of the lathe machine, the industrial robot, and the peripheral equipment in the form of two work piece storage units, a universal double gripper, the work piece clamping system, and the protective equipment. The technological unit is used in multi-machine operation with multi-spindle automatic chuck-lathes.

This solution was chosen to guarantee a high use effect. It is possible to process another work piece from the existing parts assortment, and this possibility can be achieved at a later time.

In coordination with the base organization of the FDJ (Free German Youth), the technological unit is being handed over as a Youth Project.

The use of further industrial robots and manipulators in our plant has already been conceptualized for the years 1982 through 1985 and will be made more precise following the 10th Party Congress. The future industrial robots will predominantly be integrated into existing production lines or into newly created production lines. The orientation here is to have several tool machines served by one industrial robot, to make work more easy, and in the future also to release working forces.

Dr. Karl Sorg, Plant Director, VEB Central Engineering Enterprise for Metallurgy:

As the scientific-technical center of the industrial branch on mining, metallurgy, and potash (ZIM), our enterprise has entrusted to it a high responsibility for making metallurgical processes more efficient. Corresponding to the decision of the Politburo of the Central Committee of the SED to develop refining metallurgy, the VEB ZIM has become the managing enterprise for the development, planning, and

production of efficiency means such as robot technology, microelectronic equipment, and heat insulating materials, as well as for the construction of complete metallurgical furnaces. To solve this task, branch plants in Wittstock, Leipzig, Meissen, and Grieben were affiliated with the VEB ZIM.

This objective requires a complete reshaping of some plants, the integration of new technological processes, and the training of employees for new tasks.

The central plant in Berlin was reshaped from a forging operation to a powerful machine construction operation. Many important changes are connected with this, which begin with equipment, and extend through the production organization up to the training level of the employees. In order to implement this reshaping process successfully, the main point was to make the basic idea clear to the enterprise collective and to each individual employee. What we had to achieve was that each employee applied himself personally to this difficult and even uncomfortable task. This required courage to take risks and a high degree of insight into the need. Even today there are sceptical opinions, but these are being pushed back more and more, especially by the factual accomplishments. The enterprise Party organization and all Party groups accomplished a comprehensive ideological task of persuasion. The comrades took the leadership in the battle for the attainment of goals.

The principal objectives for this were decided upon in the battle program of the base organization. One component of the reshaping of the enterprise also is the double role of the VEB ZIM as robot producer and as user of robot technology.

Active participation in the EPAG greatly accelerated the deployment of robots in the ZIM. This resulted in a great step forward. Our enterpise goes over directly from hand-operated lathes to the use of robot-loaded NC machines. At the beginning, the engineers and workers scarcely had any knowledge for mastering such modern technology, and enormous efforts had to be and still must be undertaken to enable colleagues to program, operate, and maintain the systems. On the other hand, our enterprise made an important contribution within the EPAG. The sub-group "Technological Robots" is under the leadership of the enterprise director of the ZIM. The enterprise can transmit to other enterprises detailed information concerning the industrial robot ZIM 60 that has been built in the ZIM, and concerning the industrial robot ZIM 10, which is currently under development. The partners were stimulated to make the technological processes in their departments more efficient. Initial applications could already be conceptualized. Thus, the tasks of promoting the deployment of robot technology as rapidly and comprehensively as is possible under economic aspects has been effectively supported.

In Berlin, we began in July 1980 to work out specific plans for the deployment of industrial robots in the production departments of shaping tool production (including efficiency means - single production) and forging.

For this purpose, rough analyses were performed on suitable jobs, and deployment designs were worked out which subsequently were supplemented by detailed studies for high-priority cases. The selection gave higher priority to jobs where physically difficult and monotonous work could be eliminated or facilitated and, at the same time or with priority, savings of work and release of working forces became possible. This resulted in an overall design for the deployment of industrial robots. In honor of the Tenth Party Congress, the VEB ZIM delivered the 50th

industrial robot ZIM 60. The robot ZIM 10, whose functional model was implemented for the 10th Party Congress, will already this year be used in our forging plant.

The success of robot utilization could be achieved in this short space of time only by precise planning and strict control as well as by the parallel work of planning, design, production, assembly, and testing. To prevent quality losses, the planners and designers were directly involved in working out the detailed task definitions for the peripheral systems for the deployment of the robot ZIM 60. The necessary information was therefore made accessible to them directly without time-consuming documentation.

Figure caption: An industrial robot "ZIM 60" in action, in the ZIM, the Central Engineering Enterprise for Metallurgy, Berlin. Here, in a drop-forging operation, it brings parts into an oven for pre-heating. It thus relieves the employees working from a physically difficult labor.

Our first two applications are the use of an IR2 from the production of the VEB BWF Marzahn at the NC lathe machine DF2 CNC 600 and the use of a ZIM 60 from production at the furnace of the forging press LZK 1000.

The first application was made with the support of the EPAG, but the second application we basically had to implement by ourselves. For both applications, the goal was to start up the system in honor of the 10th Party Congress in a battle program. Engineering worked out detailed task definitions and plans to prepare for the application, and these were coordinated and confirmed during basic consultations with the enterprise director.

Immediately thereafter, the two deployment collectives were formed.

For the last phase of the two application cases, we organized the work according to time-oriented networks, so that the deadlines could be met exactly.

An important management instrument also was the biweekly control consultations under the leadership of the enterprise director. In the presence of all responsible parties, the necessary specifications and decisions were here made.

What is the significance of the selective applications in a technical/technological perspective for the enterprise?

With the metal-cutting processes of shaping tools, especially for the turning of drop-forged parts, complicated surface-lathing work is required, which demands high craft skill. The individual form elements can be tested only roughly with the simple measurement tools customary in lathe work (vernier, micrometer screw). Altogether, this results in a high expenditure of time for the production of drop-forged parts with the proper quality. With the use of NC lathe machines, the total processing time should be shortened to about 30 to 40 percent of the previous expenditure. By the simultaneous use of loading robots for a portion of the anticipated NC lathe machines, we can furthermore achieve two-machine operation despite the complicated technological conditions.

With drop-forging, the other application case, there are relatively very frequent monotonous handling processes, which suggest themselves for automation. As an

initial application for an industrial robot, we here selected the conduction of parts to their being heated in the V-grooved pulse furnace.

For this application, it was necessary to develop special peripheral equipment. This equipment accomplished the task of conducting the parts oriented in position (guidance of blanks). A combination was found with already existing and proven component solutions, which reduced the additional development effort.

A device was thus produced, which partially automated loading the V-grooved furnace. Full automation is anticipated by further peripheral equipment, after collecting and evaluating the appropriate use experience.

Both applications can be put in trial operation on schedule in honor of the 10th Party Congress. The experience gained thereby will help us during the coming year to achieve the necessary faster rate of deploying industrial robot technology.

Figure caption: In the Central Engineering Enterprise for Metallurgy, in the course of converting from a forging operation to efficiency-means construction, one dares to make a jump from conventional lathes to NC machines with industrial robot loading. An IR2 leads the parts being processed to an NC lathe VF2, and again withdraws the rough-finished goods (left picture). The devices developed in the TRO within the framework of the user community are used as intermediate storage units (picture right). Program-controlled production of semi-finished goods for forging dies has been started; the complicated production of various die impressions is being tested. The work of engineers and programmers will have a decisive effect on the success.

Jürgen Nitz, Plant Director, VEB Automatic Refrigeration

The activities of our enterprise in the development, production, and user community primarily comprise working out an operational use design, which was confirmed and supported by the leadership of the party, trade association, and enterprise. This Party-Congress project was included in the battle program of the BPO (Planned Party Organization). The personnel was thoroughly informed concerning the objective of beginning, at the time of the 10th Party Congress, test operation for the initial application, namely the turning of gear wheels and other rotation-symmetric parts in three-machine operation. The EPAG deployment conception was converted in the plant into a detailed process plan for all important preparation areas and for the relevant production collective. We formed a deployment collective at the proper time, to prepare for production, and we secured constant control of the course of the work through the APO Management and the Party groups, as well as the BPO Management, the BGL (Plant Labor Union Executive Board), and the enterprise managment.

Within the framework of technical preparations, the component assortment and the machine configuration were determined, among other things, and the technological project was worked out on the basis of the EPAG type project. At the same time, the engineers and the repair personnel (electronic technicians) were trained. Together with the transformer plant and the Berlin Brake Plant, we produced work piece storage units. Precisely with this production of storage units, universal grippers, and protective equipment, which are an example of the division of labor, all the enterprises exhibited a high degree of readiness for non-bureaucratic collaboration. In this way, the capacitive, technological, and material problems

could be solved on schedule. The advantages of constructive socialist community work appeared clearly here!

In connection with technical preparations, we worked out a design for the deployment of industrial robots in our enterprise by 1985, which will be made more precise in the evaluation of the 10th Party Congress of the SED.

An important component of the preparation for deployment was the selection of young workers, capable of development, for the Party-Congress object. On 30 March 1981, this job was assigned to the young workers as a Central Youth Object. The iniative for this came from the comrades of the production area themselves. The impatience and the interest with which the younger colleagues look forward to working on the robots again proves how appropriate it is to transfer demanding and responsible tasks to young people. It is also quite logical that a colleague of the Youth Brigade now is applying for acceptance as a candidate of the SED.

Walter Liebig, Plant Director, VEB Berlin Metallurgical Works for Semi-finished Goods

Initial tests with an automatic industrial robot for operating a die-forging press have already been running in our plant since 1979. However, this did not bring the desired results, since the operating tempo with these robots fell short of expectations. Starting from this experience, we were very interested in community work with other enterprises to master industrial robot technology. The EPAG, formed in 1980, was therefore a welcome opportunity for us to approach the deployment of industrial robots jointly with other enterprises. We set as our objective to use a robot of the type IR 2/S II in our plant in combination with a highly productive tool machine, by the time of the 10th Party Congress. At the same time, we wanted to make our contribution in our working share of the process of fabricating peripheral equipment.

Due to the exemplary leadership of the user association and due to the flexible coordination of deployment preparation, it was possible to deliver the required technical equipment beginning in February 1981, to install this equipment and to begin testing. We deployed the first IR 2/S II in compound slide-bearing operation. Here, it is used to load a chuck lathe with microprocessor control system of type DF2 CNC 600. This use suggested itself because, despite an already high degree of automation in slide-bearing production, monotonous and partly heavy lifting work must still be performed to a considerable extent at several conventional tool machines.

When the preparations for the deployment of the IR 2/S II were begun, the ideological preparation within the collective of the slide-bearing plant was also begun. Nevertheless, there were not a few skeptics who regarded the rapid deployment of this technology as impossible. In the meantime, they convinced themselves that, by concentrating all forces, even such new technology can rapidly be prepared and introduced for deployment. The technological unit, consisting of the robot, the chuck lathe machine, and peripheral equipment, such as storage, grippers, protective fences, etc., has been constructed, and test operation can be begun for the Party Congress. An essential role in this process is played by the work of the Party actives and also by the repeated support of the district management of the SED in Berlin.

After the technological unit with the IR 2/S II has been started up, work is far from having been completed. Problems must still be solved, such as the improvement of production organization and the securing of maximum load for this new technology. The lot sizes must be coordinated with the objective of processing the largest possible assortments on the highly productive unit NC-tool machine/industrial robot. Furthermore, an adaptation and/or revision of production technologies is necessary. Thus, we are endeavoring to optimize the production times with respect to the loading rate of the industrial robot, to optimize the tool lifetimes, and to improve the work piece planning system. In the short time available, two engineers have by now been trained to program and operate the system. These two colleagues are perfecting their knowledge and skills during the test run, in order to be able to properly instruct the technicians who are intended to operate the system. The user training of the operating personnel should still be qualified primarily for the micro-electronically controlled tool machines, in collaboration with the manufacturer enterprise.

In parallel with the application described above, our enterprise was involved in consultations and preparations for other applications in the collective. Thus, a design for deployment up to 1985 is being worked out, which already now anticipates some new applications for industrial robots. For example, a ZIM robot is supposed to be used to operate two NC lathe machines in the construction of operating means. An industrial robot of type IR p I will be used to operate the punch in the stamping plant, and a ZIM 60 will in the future serve to eliminate the heavy work at a pig-iron casting machine. There it will withdraw and stack pigs. We anticipate that an IR 2/S II and/or its further development will be used at other NC lathe machines in the slide-bearing plant. Some types, which have yet been precisely determined, are to be used for loading powder presses, for operating punches in consumer goods production, and for other tasks.

The basic decision has already been made for one of these applications. This robot of type ZIM 60 is to operate numerically controlled tool machines for the production of pressing tools. The solution of the task promises a significant stabilization and expansion of tool production, which up to now has been a bottleneck for us. This project will be prepared and performed according to the already tested system of the leadership. The other applications up to 1985 also involve difficult tasks for the enterprise. For this reason, it is necessary to organize the use of industrial robots in good time within the planning process, and step-by-step also to restrict the increased management efforts.

Figure caption: In the compound slide-bearing plant of the Berlin Metallurgical Works and Plant for Semi-finished Goods, IR 2/S II is used to load a chuck lathe machine DF2. This deployment center will also become a site of active exchange of experience.

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ROUNDTABLE DISCUSSES COMPUTER RESEARCH SPECIFICS

Budapest SZAMITASTECHNIKA in Hungarian May 81, Jun 81

[May 81 pp 4-5]

[Text] Since we have reported on foreign achievements we will deal in the sixth part of our series with the opinions of those involved, and in our following reports we will deal with the state and achievements of domestic research.

The ever-newer versions and generations of sequential Neumann-principle computers no longer "shake up" computer technicians. The first parallel system computers--based on modern electronic elements--appeared almost unnoticed in the middle 1960's. The reception and judgment of them still generates stormy debates. The spread and use of them has accelerated only recently. Even this acceleration is relative. There are or would be enough tasks which could be carried out in parallel (for example, parallel natural and industrial systems).

Elements operating in parallel are just now appearing in solid form in the ESZR [Uniform Computer Technology System], in the ES 1035 and ES 1055. Researchers everywhere, and this applies not only to the domestic ones, anticipate the developers and manufacturers. Among us--it appears--the difference between them is even greater than customary in the world. This is partly because, we feel, the domestic treatment of the theme lags behind its significance.

To prepare for these parts of our series the editors of our journal organized a roundtable conference to which we invited, in addition to a few of those responsible for guidance, representatives of three research trends, potential manufacturers and a few experts who had helped the preparation of the series with their professional advice:

Mihaly Sandory, candidate in technical sciences, deputy chief director of the KFKI [Central Physics Research Institute]:
Tibor Vamos, Academician, director of the MTA SZTAKI [Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences], chairman of the NJSZT [Janos Neumann Society of Computer Technology];
Kalman Bolotai, electrical engineer, technical deputy director of the VILATI [Institute of Electrical Automation];
Peter Braun, electrical engineer, chief of the VEIKI [Electric Power Industry Research Institute] Computer Center;

Gabor David, mathematician, scientific group chief at the MTA SZTAKI;
Andor Dobo, mathematician, technical-economics adviser to KG Informatik;
Andras Doman, electrical engineer, scientific worker at the SZKI [Computer Technology Coordination Institute];
Balint Domolki, mathematician, candidate in mathematical sciences, chief of the SZKI Theoretical Laboratory;
Gyula Fay, physicist, candidate in physical sciences, a chief scientific worker at the MTA Technical Chemistry Research Institute;
Janos Gantner, director of the Videoton Developmental Institute;
Lajos Janaki, electrical engineer, chief of the VILATI Computer Technology Applications Technology maind department;
Miklos Kaszas, electrical engineer, a department chief for the computer center of the Hungarian State Lorand Eotvos Geophysics Institute;
Tamas Kovacs, physicist, inventor;
Tamas Legendi, mathematician, a scientific worker of the MTA Automat Theory Research Group (Szeged);
Karoly Stuka, mathematician, department chief for the SZKCP [Computer Technology Central Target Program] Office of the OMFB [National Technical Development Committee]; and
Janos Szalai-Nagy, electrical engineer, deputy chief engineer of the VILATI.

We make no secret of the fact that with our series of articles and by organizing our conference we wanted, in addition to informing our readers, to provide a forum where researchers could meet and come closer to one another and to the manufacturers.

If the program found a good response then it succeeded in turning both research and manufacture toward the user. Our intention in this regard corresponds to the exceptions of the Sixth Five-Year Plan and to the professional policy goals of our journal.

We asked Mihaly Sandory to give an introduction to start the debate. A debate followed his presentation.

Sandory:

The three trends which we will be reporting on are not competing with one another. The question is not which is the better. What I would like to talk about, instead of starting a debate, is how these three research trends--the theme of parallel processing--fit into computer technology. Let me warn you that my views are rather extreme. Let me give an example. In my opinion, the only thing that would be a greater blow to our economy than to suddenly get an extremely large-capacity computer would be to get a computer with even greater capacity than that. We really met up with computer technology for the first time at the end of the 1940's, the beginning of the 1950's. What has changed since then? What has not changed? In my opinion, the only thing we can do now is what Janos Neumann outlined. I feel that the applications sphere for computer technology has changed somewhat and the hardware base has changed too. But the method of solving tasks has not changed and the architecture is just beginning to change. The following few thoughts will illustrate the situation characteristic of the end of the 1940's.

Computer technology was used to solve mathematical tasks--differential equations, linear and nonlinear equation systems. Meteorology, for example, was a promising applications area. Reviewing the prospects for applications, Janos Neumann noted that such a (meteorological) task would not require much more operational storage capacity--a few K--than was then being used. Today computer technology is not being used primarily to solve mathematical tasks, most of it is not being used for this.

At the end of the 1940's the reliability of equipment was characterized by a few hours MTBF (mean time between failures). Solutions had to be designed so that the probability of a faultless run was significantly greater than zero. In designing solutions today the reliability of the equipment is no longer a primary consideration. In regard to the speed of elementary operations, I might mention a few milliseconds at the end of the 1940's--to be polite. Today we are around a few nanoseconds.

The number of logic elements built into a single system can be characterized in many ways. As opposed to a storage of 4,000 words (not random access in the present sense but still something which could be called operational) a storage capacity of 10 M bytes is not so fantastic today. What has to be compared to the 4 K of that time would today be over a G byte. A good programmer then, and today also, produced, or produces, a program of about 10 instructions without an error. But today this is done in such high-level languages that we again have a different order of magnitude from the viewpoint of the task. If I start to add up these figures then, depending on one's temperament, if I may say such a thing, our possibilities have increased by 12-14-16 orders of magnitude. I know of no example in the history of mankind where quantitative changes of this order of magnitude did not cause a revolutionary qualitative change. It is my feeling that this revolutionary change has not yet taken place in this profession.

Speaking of task solution, Janos Neumann said that an intelligent man prepares the solution for a stupid machine. The machine cannot take part in the preparation. Thereafter the machine can execute the task even without the intelligent man (disregarding the operators). This model worked almost without change up to the beginning of the 1970's. Even today we pursue this model in most fields. The first initiative which was able to go beyond this--as far as I know--was in the area of designing computer technology devices and machine industry, construction, etc., tools. Even here they insisted for a while that filters, resistance networks, etc., had to be designed with a computer. When they faced slightly more complicated tasks they invented the suffix "aided" to help them take the next step. They could no longer design "with" a computer but the computer could aid the design. This is one area where another step would be timely and where it would really mean a revolutionary change. Naturally there are new initiatives, but I do not know of any considerable achievements. This might be one of the chief questions--in my opinion it is the crucial question--in the application of computer technology.

I would like to mention a few more thoughts in connection with the direction in which we might progress. We might introduce learning, artificial intelligence, or some more limited interpretation of these, the acquisition of experience into problem solving. In the introduction I mentioned meteorology. One can make a

meterological forecast in two ways. Either we have one great world model and, using this, beginning with data measured in Siberia, we feed everything into a computer and a huge program processes the whole thing and predicts: "Tomorrow it will be 12 degrees Celsius above zero...," and the next day a person sinks into the snow on Szabadsag Mountain. Or we could do it like the Balaton fisherman who does not know what a world model is or where Siberia is; he looks over to the other shore and says with great certaiuty what the weather will be like tomorrow, and you can count on it.

The one is a sort of learning process, acquiring experience, a process of applying information to a new area. And so is the other.

Artificial intelligence research insists on a more demanding solution to the problem. In my judgment, however, the technical possibilities are still capable of serving only a less demanding method.

The second big question (we are now going beyond problem solving) is architecture. There are two essential things here. In the first place let us look at the address. In our computer technology devices the data, instructions, etc., must have some sort of address, true or virtual, because that is how we find and use them. Database management has raised the possibility of associative access, access according to content. We can already see results in a narrow applications area. Even today, in a task where the largest part of the costs of problem solving are made up of a large peripheral (large background storage), it is not incredible to say that we could address according to content. We could read into the operational store only the relevant information from a background storage. This is not much compared to what even a 3-4-year-old child could do in regard to addressing by content--at the level of association. The question also arises whether we need to be as deterministic as we try to be in solving the entire task. Might it not be possible to tolerate a little uncertainty? Permitting some uncertainty would not only make the whole thing more human but probably it would also have an effect on the "philosophy" of problem solving if we did not stick so strictly to determinism. Associative storage elements already exist on single 2-inch or 3-inch silicon sheets. They are not for sale but one can see them and work with them--if not in the area of Greater Budapest. This trend is very promising. According to estimates, if the number of elements is improved by two to three orders of magnitude, increasing element density, then the present technical-economic difficulties can be overcome.

The last question area to be examined is parallelism, which Neumann said there was no need for. He added that if there are two of something, that is not yet parallelism because one of them is the bottleneck. Parallelism is the parallelism of problem solving. We have already heard in the introduction that there has been very significant progress in this area in the last 6-7 years in several directions. But I would like to note that the restriction which Neumann made is still sensible. It is well known that two elements working in parallel (which cost twice as much as one element or a little bit more, because we always invent something which must be built between them) is not a "well-engineered" design. The efficient solution of a task is not simply a "parallel" something. According to some, performance can increase as the square of the price, according to others it can increase exponentially. So simple parallelism is not efficient.

Those ideas about which there will be talk at this conference will not only make things parallel. They will be attempting a parallel organization of problem solving and of the entire system.

So, to sum up: Parallelism is an essential area where there are possibilities for progress, not only in general but concretely for us too. And I even hazard that there is also a possibility for progress suitable for direct practical use.

In my opinion, however, this is not the only, chief, or most important problem of the basic problems of computer technology. Starting with problem solving we must bring something new into our lives and in a manner similar to what we tried in associative solutions--and not "synthetically associative" solutions--there may be gradual progress in the other questions also. In a 1-year seminar series which ended the middle of last year we examined all the possibilities for progress and, if my deductions are good, a much better path cannot be seen even today (as compared to the others). In my opinion, a correct--if unaccustomed--way to distribute the moneys intended for research would be that if the task were assigned to me then I would proceed as follows: I would look to see where the best proven experts were and I would concentrate on that area. The differences between areas are not so great that I would not attribute greater significance to whether someone really achieved what he set out to do.

Debate

Domolki:

In reviewing the development of computer technology there was mention, among other things, of the fact that, for example, the time between failures is no longer a limiting factor in the execution of tasks and there was mention of a development of some 12-14 orders of magnitude. In this connection, one must point out a new limiting factor which did not exist in the past. I mean the limitations deriving from the complexity of the software, that is, the size of the task which one man or one group of people, with the aid of the technologies at our disposal, is able to formulate. It is probable that the limits deriving from this are already a substantial constraint on that development of 12-14 orders of magnitude! Why do I say this? Because I feel that one might imagine here a possible bridge between the two developmental trends mentioned. One is the need to revolutionize problem solving and the other is making use of parallelism; in essence, to increase "fieldless" computer-technology capacity. If we are to overcome this software limitation it is probable that we will need programming technologies which are very machine intensive, both in program development and in the course of executing the program produced. I would like to refer here to the applications of computer-aided design in software design and preparation. If such methods are to be used acceptably there will be, among other things, a need for a great increase in performance, which only parallelism can ensure.

In a slightly different vein I would like to mention the problem of artificial intelligence--not limiting it to learning. I believe that only an intensive use of the tools of artificial intelligence in programming will bring the mentioned revolutionization in the method of problem solving. I will not go into detail now

because the theme today is not primarily concerned with this.

Sandory

You are touching on the two great "blows" mentioned jestingly here. My question is: Who will "teleprogram" this great computer technology achievement and who will use it? I am in agreement with Balint Domolik in that what I also consider necessary is the preparation for problem solving.

Stuka:

The first idea is really very true and I can very much agree with it; not only would such a computer be a great blow to society but also to computer technology itself. For the past 2 years, 70 percent of the software society of the world has been writing assemblers, editors, text editors, monitors and the like and they are continuing to write them as a function of the development of microprocessors. If a new type of architecture should appear, then we would begin to make analogous tools for these. I have no debate with the methods for distributing developmental moneys but I would like to inquire into it better. In my opinion, the developmental moneys should be put where we are best--and we have achieved rather nice results in this cell automat thing, compared to what we have invested in it. So my question is whether you have a somewhat more concrete opinion about this question.

Sandory:

It is not because Tibor Vamos and Tamas Legendi are sitting opposite me, but I would like to say again, and more concretely, that if there were some money for research and development I would not consider it a clever policy to say, "Dear Comrade Vamos, you are the only academician in the trade, the key question now is the 'philosophy' of problem solving, you put together your group and you will get the money to develop a 'philosophy' of problem solving." We must work in a direction in which we have proven ourselves. Or let us take Tamas Legendi; he deals with cell automats. The direction in which he has started has certainly achieved something more than threshold results and a correct research policy should support this. If I were not the "science guide" then I might say that I am not faced with two--Tibor Vamos and Tamas Legendi--but, let us say, seven; and why should one be worse than the other? But if the seven represented a group ("school" is a big word) which could achieve results really recognized even at the international level, then I would not hesitate to say that however good an idea an eighth might be (and whoever's nephew discovered it) we should not deal with it. I do not want to make propaganda for these two groups, but we should stay where we have achieved something already and not try to guide research with some pretext or ideology. From a certain viewpoint, software technology is obviously one of the fields to be cultivated. (Balint Domolki has already used this expression.) Software technology also is an area where we have already achieved results and which must certainly be supported, although sometimes this can cause something like a nationally stressed program or the development of software technology for a nationally stressed process. This gets to sounding a little childish; a man who knows how can do it; he doesn't need us to make a nationally stressed program out of it. And a computer-technology community of domestic size cannot hope to make a breakthrough in this area. In

this or that narrow area of cell processing or artificial intelligence--I do not want to omit anything--it can be imagined that there might be a recognized breakthrough with the resources available in Hungary.

Vamos:

If I may add something to and reaffirm what Mihaly Sandory has said then I may be able to anticipate a few questions. If a good idea comes up, what policy do we follow? In general, that of the MTA, that a written draft should precede the debate. If the person who thought up the ideas can put the question in an acceptable and "professional" mathematical form--I am taking mathematics in its broader sense here--in accordance with the strictness of mathematics then he writes it down and then it can be debated because this is a basis for debate and not a collection of drummed up slogans, a conglomerate of ideas collected from various international journals. If the dissertation is beautiful, good and sensible than one says: There is that beautiful IBM computer, be so kind as to make a model of more acceptable scale thereon, something in which the complexity of the problem will appear in some form also, not just a simplification. It is certain that we cannot permit a researcher to go out, like a child, and buy 50 chips and start to fabricate something out of them. If he finishes this second phase, then we can make comparisons, what can be achieved in a given task in terms of operational speed and other characteristics. If all this has been done, then we can examine how it can be realized at the given technological level. If we follow these steps, then we do not have the question of whether or not to allocate money for such a "work"; the whole thing fits into the natural process of the progress of research.

Dobo:

I feel that friend Stuka has taken a preventive approach in his posing of the question, from both sides. Following this I come up with the following idea. What would have happened if, at the initiative pertaining to the manufacture of the atom bomb, Jeno Wigner, Leo Szilard and the others had received the answer: "Gentlemen, you will get everything you need, but first make an atom bomb and prove that it is good for the intended purpose."

Sandory:

As I understand it, the atom bomb was one of two possibilities, they started two programs, the rocket thing and the atom bomb. I do not see two such things today. The cumputer-technology world war is before us, and we cannot designate two such things upon which we must concentrate. We cannot say anything more clever than: My friends, deal with what you understand. It may be that 1 year from now or 2 years from now the situation may change, as a result of chance or a deliberate discovery, and we will be able to say that there is this program and that program--the atom bomb and the rocket thing--and we must concentrate on them. I do not see such a thing today, although at the year-long seminar series mentioned we went through the world literature very conscientiously and in detail. Many brought direct experience from very many places abroad. There was only one thing in which, if I may say so, we agreed and that was this: There is no single best possibility. There are many equivalent things of equal rank, and this seems to be the opinion in

official research guidance also. In February of this year the first secretary of the MTA said, in connection with stressed themes, that in the area of automation we should regard as stressed research that research which we were doing and we should not try to think up one theme and say that it was the stressed theme.

Dobo:

Then let me put it differently. I do not know if it is correct to take this wait-and-see position simply because for the moment I do not see a problem the size of the atom bomb. Nor am I convinced, and this is not distrust of the talents and abilities of the representatives of the profession, that we will come with a correct judgment however much we survey a thing. They analyzed the situation of the atom bomb in many countries. Very many countries came to the position that they could not have an atom bomb within a foreseeable time. But I am afraid that simply because we do not see a great task, that does not mean that there is no great task. In the second place, neither am I convinced that we have to see a great task, because what we do not feel to be a great task today may become one the day after tomorrow.

Stuka:

In a word, what Mihaly Sandory said can be applied to that part of the money which we can turn to research and development. Many justly ask the question: Where are these moneys coming from? Where are they coming from, where are they generated and what percentage, by international standards, can be turned to basic research? So my question would be: Can we turn larger sums to basic research purposes? Is there a realistic prospect that the branches producing the wood will get something back within a realistic time?

David:

I feel that what we are talking about here is a gate that is opening or is already open, more precisely, we are talking about knocking at open gates. This is partly because even Karoly Stuka has represented the SZKCP. It is my feeling that in the past 3 years a part of the moneys handled by you have gone where the new research is. (It is not certain that money went to every such place!) And if we can talk about opening gates--thus not about a finalized document--then I might say the following: In our upcoming plans there are four themes in architecture. Three of these are linked very closely to parallelism. One is parallel at a very high level (the cell automat trend); another is the architecture of adequate computers which might be developed in accordance with a better structure of the problem class; the third is the architecture of computers which reflect and aid problem solving. These themes figure in the plan proposal.

Sandory:

I am a disciplined citizen. That sphere about which we are now speaking is a part of culture. On the basis of "small change"--with a shortsighted view--we cannot see research except as a series of different things; so we must think of a longer term. The weight of technical development is entirely different; naturally, the

fields are contiguous. Let me hazard here a "supplementary position." If reseachers who understand what they are doing develop something, then technical development is more likely to achieve research results (which later can be made into products) than if they developed something in some field simply to have something which could be sold well on the world market. But I recommend this model for research goalsetting expressly for the allocation of moneys decided on by the MTA. Technical development funds must be distributed according to different viewpoints; but a part of the technical development fund will obviously have a mutual effect with a part of the moneys turned to pure research. I do not want to influence opinions, but in SZKCP matters (for example, long-range research--if there is any) we should not choose as a theme what one reads about in ELECTRONICS or in the COMMUNICATIONS OF THE ACM but rather what someone can really do here at home.

[June 81 pp 4-5]

[Text] Many in Hungary are dealing with parallel processors or cell processors; they are interested in this, publishing about it and reading about it in the literature. But there are relatively few who have been able to achieve new results in this field. It would be difficult to determine the reason for this. In a complex way this is influenced by such factors as centrally supported research, the medium in which researchers exercise or can exercise their activity, the technology or element base at their disposal, prices, knowledge of user needs, cooperativeness, industrial interest or incentive and the official judgment of this or that trend. But the adherence to traditional sequential systems may contribute to these causes also. I feel that it is an impossibility to list the causes of this in an accusatory manner. The arguments of our researchers, the opinions voiced in debates, clarify much. Our editors cannot take a position but we are providing a forum for these opinions and differences.

Of those researchers who want to achieve new results let us introduce three Hungarian researchers who represent three paths in the area of research on parallel systems and cell processors: Andras Doman, Gyula Fay and Tamas Legendi.

(The introduction of the researchers and their work is by the editors; then the researchers themselves report on their achievements.)

Paradocs and Dataflow

Andras Doman has been dealing for several years with general questions of parallel information processing and high-speed computation. In connection with this, he is doing research on a computer using the Dataflow principle and as a result of this he has developed a basic model for a large parallel computer with distributed control, a model which includes the operating principle, architecture programming system and basic applications. Small-scale experimental construction of the proposed computer is under way. His research in the past 3 years was done on a postgraduate scholarship; one condition for successful further research is that the work go beyond its one-man nature and link up with other areas as a result of appropriate concentration.

In addition to his foreign articles, Andras Doman has significant domestic publications (for example, a professional bibliography) and lectures with which he has

tried to acquaint others with foreign results and the important theme of parallel computer systems.

The goal of Andras Doman's research on computer architecture was to develop a model which would have a high degree of parallelism; it should have simple construction, be receptive to the newest LSI/VLSI technology and be effective for the solution of universal tasks but especially of tasks demanding much calculation and of tasks involving essential parallelism. The name of the proposed computer is Paradocs; it is a Dataflow computer with a high degree of parallelism. The four parts of the work connected with the computer model are:

--developing a basic model incorporating the operational principle;

--developing the architecture (system, processor, processor element);

--developing a programming language to fit the basic model or atchitecture; and

--developing applications areas and algorithms.

The operation of Paradocs is based on the so-called Dataflow conception, the most important basic thesis of which is that the computing process can be broken down into elementary operators, linked with data channels and that these operators be executed when, and only when, all arguments (operands) are available. Its chief advantages are:

--data control (instead of central sequential control);

--the possibility of maximal (microscopic) parallelism without the necessity of explicit synchronization;

--a deterministic parallel computer model; and

--the computing model does not contain a traditional central storage.

Based on a modified version of the basic Dataflow model the Paradocs computer provides for simple realizability, distributed control and unlimited expandability.

Its architecture is essentially a block-structured network of uniform processor elements in which every processor--imagined as grid points in a three-dimensional space--can exchange information with six other processors. By "programming" in this so-called physical configuration, one can develop a logical configuration which is a representation of the Dataflow graph of the algorithm to be solved.

Transformation statically assigns to the processor elements a singel operator (direct implementation) or a substructure consisting of several operators. In the complete computing system, the Dataflow processor is the control computer (host) linked to the processor.

The Dataflow language (DFLL) recommended for the computer is a SIMULA-67 base functional language implemented on a CDC-3300 computer. A high-level applicative

Dataflow language which also contains data structures is now being implemented on a PROLOG base.

Efficient applications areas for Paradocs include tasks which have algorithms which are well structured in the geometric sense, have a pipeline character, are essentially parallel, etc.

Applications areas which have been developed or proposed are: real-time processing, linear equations, ordering, querying, picture processing, nonnumeric processing, etc.

Doman:

Performance-oriented computer architectures occupy a leading place among developmental trends in computer architecture and these include parallel computers or, to use the "vulgar" expression, supercomputers. The requirements which arise in connection with research can be put essentially into three main groups:

--A radical increase in performance at an acceptable price. This radical increase means an increase in speed which results in a qualitative change. Thus it becomes possible to carry out tasks which could not be carried out earlier due to speed limitations. Some estimate that the speed of these supercomputers will have to fall in the region of 1 billion operations per second in order to attain this qualitative change.

--A great development of present technology, which will pose certain changed requirements in connection with architecture. This includes such requirements as, for example, using as many elements as possible, elements which are relatively highly integrated and limited to a few types and which are placed as far as possible in some regular connecting structure.

--A requirement connected with programming problems. The programming systems must make it possible to fully exploit the new architectural possibilities from the user side and must ensure simplicity and verifiability of programming. It can be seen that the first and third requirements are in serious contradiction with one another, at least within the frameworks of traditional architecture and programming systems.

Let us return to the radical increase in computing performance which, since we are talking about parallelism, will require a large number of processor elements. The basic problem is to get this large number of processors to work together. The following ideas arise in connection with the type of computing system which would be capable of such high performance: It should have distributed control (because central control is the thing which represents the actual limit on increasing speed); insofar as possible, communication between the several elements should be local, without centralized communication (because this is required by distributed control and processing).

All these considerations have led many researchers to the trend of so-called Dataflow or data-controlled computer architecture.

The Dataflow computing model tries to satisfy, in a computing system, the natural requirement that the execution of the several instructions should take place if the arguments of the instruction are already available. This is a natural requirement in traditional programming, too, but only in an implicit manner, is it reflected in the structure of the user program, but with a Dataflow system this is ensured by the execution mechanism. This is an important idea because this makes possible the conflict-free cooperation of various computing processes; at the same time, central control and other central resources are "eliminated" from this conception. The advantages of Dataflow computing systems are already well known: maximal (microscopic level) parallelism, asynchronicity, determinism, freedom from side effects, etc.

My work is directed at the development of a model of a parallel computer which can make use of the advantages of the Dataflow principle to a large extent in an actual architecture which can be easily realized.

During task solution, the algorithm can always be given in the form of a computing graph and, adjusting the Dataflow executive mechanism to this, we get the Dataflow graph, which is the basic machine language for a Dataflow computer. The task to be solved was a double one: In the first place to provide a principle and a tool for providing the algorithm--this is the modified Dataflow model (DEM) and the developed Dataflow language; in the second place we had to develop the architecture for a Dataflow computer which interprets the basic machine language.

The architecture is a special one with completely distributed control which contains a large number of identical processor elements in a regular geometric linkage. This choice resulted in the inclusion of the advantageous properties of cell automats in the architecture and the architecture shows a structural similarity to an algorithm in which parallelism and the speed requirement are critical. The operation of the computer consists of two phases: Loading, in the course of which a representation of the Dataflow graph (logical configuration) is loaded into the cell-like processors (physical configuration); the second phase is operation, during which the logical configuration continuously realizes the Dataflow executive mechanism. The biggest problem for this system is that it requires a very large number of processors and these processors are not fully exploited. At the same time, this system can provide maximal parallelism. As one solution to the problems which arose we developed an alternative architectural model which requires a substantially fewer number of elements with high exploitation of the processor elements. Here the individual processor elements do not represent a single "software operator" but rather they execute sequentially the larger partial structures of the Dataflow graph--preserving operation according to the Dataflow principle and preserving the cell-like architecture.

Experimental realization of the proposed basic model is under way. Within the framework of a research contract signed between the MTA SZTAKI and the BME [Budapest Technical University] we are constructing six to eight processor elements and the associated interface. In the full system, the Dataflow processor will be a linked processor to the central control (host) processor which also carries out communication tasks.

The other areas of research, in addition to the computing model and the architecture, are: development of Dataflow programming languages and discovering applications possibilities. I worked out and implemented in the SIMULA-67 language a Dataflow programming language which is a simple descriptive language for optional parallel algorithms. A high-level applicative Dataflow language is also under development; it too will handle complex data structures. A very important area of research is the discovery of applications possibilities. We are considering tasks which can be solved much more efficiently on a parallel Dataflow computer than in traditional computing systems. A few of these are: real-time processing, matrix operations, large-scale physical models, picture processing, nonnumeric processing, etc. For the most part, the algorithms for these tasks have substantial parallelism (a large number of identical computing patterns), they are of the pipeline type, interactive algorithms and well-structured parallel algorithms.

I feel that further research will be given a great impetus with the appearance of concrete applications needs and with the development of broader domestic and international professional contacts or cooperation.

MIND-80

Cell automat research began in Hungary in 1972 at the initiative of Gyula Fay.

For a period of 2 years the Lorand Eotvos Science University held a special collegium (for physics and mathematics students) and several who got their degrees as a result became co-authors of the anthology titled "Cell Automats" [Sejtautomatak] which appeared in 1978.

Among the first to join the work of the team formed under the leadership of Gyula Fay were Andras Doman and Tamas Legendi, who have developed independent research areas since then. Their present research is directed at a systems technology synthesis of personal computers and cell automats. The basic idea was given by a 1976 patent, held jointly with Tamas Kovacs, which was realized in 1980 in a computer named MIND. As for the theoretical approach, Gyula Fay considers himself a follower of the Aladyev type cell automat school working in the Soviet Union and he is striving for implementation on an ESZR base.

The MIND-80 is a protable personal computer. Its purpose is to increase or enhance the intelligence of the user in the broadest possible sphere of situations. This is why it has the acronym MIND--an artificial intelligence-increasing dialog partner.

In construction, it is a microelectronic device based on a microprocessor and it contains 1x8080, 8x2147, 8x2708 and 1x8253 integrated circuits. In regard to operational mode, it is an adaptive automatic system with model reference.

Since it is an adaptive system, its operation is constantly formed by cooperation with a human. Its being a model reference system means that its built-in programs presume an average general school education of the partner. In the course of cooperation with a human, the computer constantly measures the information level and degree of intelligence of the partner. (By watching the number and character of the error messages required.) In accordance with this, it constantly modifies

its partner model and in this way it condenses or details its messages (redundancy-adaptation) in the course of the dialog. In this way, getting acquainted with and cooperating with the computer are inseparably intertwined and the total capacity of the man-machine system develops in accordance with the intellectual capacities and will of the human.

In the course of cooperation with the computer at a suitable informational level of the partner, it becomes possible to gradually eliminate the design deficiencies of the machine and the errors which arise in the meantime and to develop new functions; that is, system development becomes possible also.

It is an automatic system. This means that the functional system of signals used with the human develops via a system of human influences, machine conditions and feedback signals (a fivefold system consisting of input-condition-output-new-condition-new output).

In accordance with the cell-automat principle, identical models of the MIND computer can be linked together theoretically without limit and thus their capacity can be combined. Thus they are capable of taking the place of large computers. This is made possible by the fact that present microprocessors are capable of mechanical self-isolation ("hardware-triggered hold state"), thus making their stores free to neighboring machines, presuming that in every environment only one machine is connected to the data and address channel. In the case of the INTEL 8080 microprocessor, the isolation ties down an entire five-phase machine cycle (maximum of 2.5 seconds). This includes the time needed to communicate the prior state and read the state. Since the MIND computer does not have peripherals in the systems-technology sense (its operator console and display are also directly addressable stores), the exchange of information concerning the state of neighboring machines ties down at most two machine cycles (together this surely can be kept under 10 microseconds). Data traffic can be ensured with a transmission frequency of 100 kHz.

There is no need for any sort of separate switching time or sequential-parallel (modem) transformation. There is no code generation, parity check, correction, etc., and no extra software work because the computers use the store of neighboring machines as their own. This takes place via hardware so there is no separate time requirement. The development of MIND states and temporary funcitons takes place with standard cell-automat techniques.

Fay:

Demostic cell-automat research began in 1972 in a Budapest organizational institute, the KGM ISZSZI [Institute of Industrial Manggement, Organization and Computer Technology of the Ministry of Metallurgy and the Machine Industry]. The idea arose in connection with organizational work being done for Videoton. The research work, supported by several million forints, lasted 1 or 2 years, then the institute was reorganized and the work connected with this ended. But research continued in another place. The role of Tamas Legendi, especially, was significant; since then a regular school has developed around him in Szeged.

A new direction came into being when I got in contact with Tamas Kovacs. It was his idea that the microprocessor idea, which was appearing and fashionable then,

might be combined with the cell-automat idea. The patent for the MIND personal computer came in 1976 and the machine itself in 1980.

Adaptive production control is the chief applications area for the MIND system. Its chief design principles and orientation (its "philosophy") can be summarized as follows:

--It attempts to achieve environmental balance, that is, to see that the speed of input-output processes (thanks to a high degree of hardware parallelism) approaches the speed of internal (central) data processing. This is done by connecting and disconnecting the individual cells. As far as we know, the concept of environment is explained only by the thermodynamics of processes which cannot change direction, by environment economics and by topology. Not by computer science. This is the reason that peripherals are usually treated differently in principle from stores. An indication of this is the fact, for example, that the INTEL 8080 microprocessor has separate OUT and INP condition indicators for handling peripherals and the fact that the firms manufacturing electronic keyboards (for example, Haussmann) supply the keyboards with expensive electronic cycle protection when they make them for microprocessor peripherals. (Naturally these are completely superfluous when we treat the peripheral uniformly with the store--from the conceptual viewpoint.) The distinction of a contraentity concept of the environment (in our opinion, false and distorted) is entirely alien to the cell-automat view. In microprocessor system technology this approach merits the designation "Memory Mapped I/O" (see, for example, the "MCS 80/85 TM Family User's Manual," published by Intel Corp, Santa Clara, California, USA, October 1979); to its detriment they say that "it takes addresses from storage" and "requires 3 byte instructions (LHLD, SHLD) instead of 2 byte instructions (IN,OUT)." We do not agree with this.

--In the accelerated development of computer technology the formalism of a contraprocess description of results is tilted entirely toward the process side (procedurality) while th the classic chapters of mathematics the recording of results (usually in the form of equations and formulas) is exact and formal and the description of process is loose and verbal (we think of such expressions as "let us note that.." or "let us substitute..."); the situation is turned around in computer technology. Result description is verbal and limited to the COMMENT column, and thus it becomes loose, while the description of processes takes place in formalized program languages. In the MIND system we are trying to eliminate this essential difference. The developers of the MIND see the cause of the well-known sorry efficiency of software development in the fact that it is simple absurd to seek errors and correct errors in formal systems (such as programs) with essentially verbal tools.

It should be noted that the formalism of a uniform description of results and process was worked out well before computer technology in the "Principia Mathematica' of Whitehead and Russell.

--In the development of the MIND system we are also striving for a natural balance of the man-machine link. As is well known the time-sharing system discovered by Gabor Kemeny represented the first step in the direction of a "human collective-machine" link on the path of the development of the man-machine link. The next

natural step will be when human collectives face machine collectives (computer networks). Human thinking is a social product and could not have come into being without human collectives (social groups). Computer networks can be conceived of as extensions of the collective thinking abilities and organs of social groups of humans in contact with computers (with their structured systems) and using them as tools of production. This means--going beyond the customary relationships of time-sharing systems--that we attribute a crucial role to an enrichment of the communication relationships among the members of the collective in contact with the computer network (cell space) via a mutual effect with the machine collective.

--"Redundancy-adaptation" is characteristic of man-man communication; that is, in the course of communication the redundancy of messages constantly adapts to the communication processes. (People understand one another even with "half words.") the YKWIM concept ("you know what I mean") has already appeared in modern computer science, in research on artificial intelligence. We want to proceed in this direction in the development of the MIND system.

--In computer science the originally inseparable triple semiotic unity of syntax-sematics-pragmatics long developed in a distorted way as a result of the complete neglect of pragmatics. As a result of the work of J. Bar Hillel, R. Montague and R. Kowalski, however, pragmatics began in recent years to receive its proper place in the computer technology semiotic relationships system. Pragmatics means that we can also formalize that interpretation structure by virtue of which man interprets the significance of signs. Using the expression of Quine, this interpretative activity is "enthuematic" (that is, it takes place by means of the accumulation of implicit conjectures with extraordinarily many nonformalized detours and transpositions). In computer science, little thought has been given to the formalization of enthumematics although, in 1950-1952, R. Carnap laid the conceptual foundations by starting the theory of explication (and Robinson, Wang and Kowalski, among others, developed the technical tools). (For comparison, see mechanical theorem proof or the PROLOG language.) As far as we know formal program correctness tests at the assembler level are still rare. But they play a priority role in the development of the MIND.

The L Processor

Tamas Legendi is chief of the cell-processor research taking place in the Automat Theory Research Group of the MTA. His publications are well known and cited here at home and abroad. We should mention his proposed cell-processor architecture which he calls the L processor. The new concepts introduced by him are spreading--such things as cell processor, cell algorithm, cell program and cell microprogram--and what is more important the work of those in Szeged is giving concrete technical content to these concepts. In 1978 he received the MTA prize for basic research.

The successes of the research group are proven by, among other things, the results of the basic research done within the framework of a several-year contract with the SZKI [Computer Technology Coordination Institute], the long-range research cooperation established with the Scientific Academy of the GDR and the results of the joint project conducted with the Braunschweig Technical University on the basis of an MTA-DFG [German Research Association] interstate agreement.

The cell-processor school developing in Szeged has made possible or provided a framework for more than 50 diploma theses; they have written several prizewinning OTDK theses, university doctoral theses and monographs.

In regard to scientific organizational activity we should mention his creation and leadershpp of the Parallel Computing Group of the NJSZT [Janos Neumann Society of Computer Technology] and the preparation and conduct of NJAZT conferences and its congress. Tamas Legendi was invited to be a member of the program committee of the CONPAR 81 parallel programming and problems conference (Nurenberg, 1981) and to participate as a speaker.

The goal of the Szeged cell-processor project is to design, create, program and put into use universal and special purpose cell processors, which constitute parts of computer systems, which are faster and more powerful by several orders of magnitude than traditional computers (have greater computing power with the same quantity of hardware).

The theoretical background for this work is the traditional cell-automat theory which was laid down by Janos Neumann and significantly further developed by A. Burks and Codd. Several hundred works on achievements in this area appeared in the 1970's. (From 1972 to 1974, Guyla Fay and his group were the pioneers in Hungary.)

In the course of the development of computer technology the single-processor, centralized, sequentially controlled computer long reigned alone because of the greatly restricted machine size resulting from technological limiting conditions. Because of increasing demands, the speed limitations and organizational problems of these increasingly became obstacles to further development. With the appearance of LSI technology, the path was open for substantially larger system dimensions. A study of various parallel architectures became a realistic research and development trend and we began to see research results and models for vector computers, multiprocessor computers, associative processors and Dataflow processors, and even some operating devices.

Compared to this, cell-processor research lagged behind because even with the increased system dimensions the theoretical achievements did not make directly possible the creation of "cell-automat computers" (this would still require a machine size greater by several orders of magnitude) and the programming of effective cell processors for practical purposes remained a completely unsolved, open question.

In order to solve these problems, those in the Szeged cell-processor project developed a cell-processor architecture family containing cell fields consisting of many small microcells which make the creation of cell fields of several tens of thousands a routine task and the creation of cell fields of a hundred thousand a task which can be solved realistically with existing (8080 level) technology.

The Szeged cell-processor researchers developed a cell-programing methodology and prepared and ran, in their large-scale simulation systems, cell algorithms on the order of one hundred.

These cell algorithms are very efficient--they require a minimum number of cells, and the great majority of the microcells are in continual useful operation. The

majority of the cell algorithms are bit-parallel, thus execution time is independent of work length and the cycle time is the execution time of the bit-level operation.

A unit which carries out the number and size of operations needed for the task can be loaded into the chief operation executing unit of the cell processor, the cell field, thus the software configuaation ensures the flexible adaptation of the computing system to the computation to be carried out. All this together results in the efficiency and speed.

The average user will use the cell processor indirectly via new system macros or via the services of an operating system and language system based on these. Suitable host software in the computer controlling the cell processor ensures storage of the new system macros and their execution in the cell processor.

The obvious advantages of the homogeneity of manufacturing technology circuits which repeat even on one chip, design which is cheaper and faster by one order of magnitude hundreds or even thousands of identical units in one piece of equipment) and the change in architecture which can be expected with the appearance of electronic background storage (realistic system balance will require high-speed processors capable of processing a large data flow) both support the justification and viability of cell processors.

The achievements unfolding in related areas (parallel computing systems, parallel algorithms, interactive blocks, gate blocks, circuits especially designed for users, FPLA's, PROM-based logics and the design requirements of VLSI development) also indicate that cell-processor research is beginning to become part of the main trend.

On the basis of the results achieved in the Azeged cell-processor project, Tamas Legendi definitely asserts that "the creation of cell processors has become possible within a short time (2-3 years) and their realization is only a question of leadership, financing and parts technology."

Legendi:

In order to characterize our work thus far, I would like to say that this is a complex research project or proposal leading up to introduction in industrial development, one with very concrete partial achievements. This project can be realized in Hungary in the near future with existing technology. We are striving to serve primarily not what is most interesting but rather what will be mass applications needs within a foreseeable time.

By complex, I mean that the project consists of a number of parts which are different even in character. It is a sort of fulfillment of the criteria and requirements demanded by Tibor Vamos that we carried out a certain clarification of the theoretical foundations. Nevertheless a cell processor does not yet exist (although cell-automat theory is the best developed part of parallel theory) simply because there is a very large gap between theory and the machines which can be made. We had to bridge this gap by developing (a little) the mathematics of finite and inhomogeneous spaces in place of infinite homogeneous spaces. Then we could make design proposals. On these theoretical foundations, we did a great deal of work to develop special simulation languages and processors. On the basis of these, we ran a large number of cell algorithms (on the order of one hundred), cell programs

which became increasingly complex also still a limited and rather small applicable cell-program packages have been run. The most noteworthy achievement by international comparison may be that we already have such a quantity of cell algorithms or cell programs. I know of no similar achievements in the "open" literature. I have also proposed a very concrete cell-processor architecture. These algorithms or programs can be run on the proposed architecture. I have also planned how this cell processor should be integrated in a natural way in the architecture of customary computers, hardware and software, without the user having to learn any new cell languages--one could not count on this in the near future anyway. Our articles, appearing in about two dozen domestic and foreign forums, report on this architecture. I would like to note that the most essential part of the cell processors is the cell field. This cell field is made up of very small microprogrammable microcells. The fact that we chose this microcell approach was not simply a search for research beauty but rather it was a condition for the creation of cell spaces on an order of magnitude of 10,000 or 100,000. The experiments known to have been run thus far on the basis of traditional cell automat theory failed because they proposed cells containing microprocessors equivalent to about 1 unit and for practical applications one would have needed millions of these.

The proposed architecture ensures the creation of cell processors containing cell fields on the order of 10,000 or 100,000. We have created very efficient programming methodologies and concrete cell programs for these. I even dare to make the more pointed statement that within a foreseeable time it will be possible to create systems containing a large number of cells which consist of two-dimensianal cells of very small size, no longer than about 20 to 100 gates. Within the project we have already started long-range applications research too; since 1978 we have prepared five studies for the SZKI and I feel that we have received very effective guidance and feedback so that we are preparing applications studies for really definite practical problems. We have prepared data-processing, process-control and picture-processing studies with cell programs which have been run in detail.

We already see the posiibility of realizing in our homeland a special-purpose computer for which there is a mass applications demand. This would be a sorting machine for which the KFKI [Central Physics Research Institute] will manufacture the sorting chip with technology at the INTEL 8080 level. They have prepared the masks and the first test chip, which contains one cell.

Preparation of the 128-bit full chip will take about 1 1/2 years. We have finished plans on how to put together a complete sorting computer from this (64 chips mean a sorting capacity of 1 kbit). A processing speed independent of record length is characteristic of cell-organization bit-parallel processing ability so it could sort byte or 2-byte words or 100-byte records at a rate of 5 Mrecords per second. This speed is too great for traditional computers today; they can handle only a smaller data flow. This means that our architecture will become truly efficient if in the course of the 1980's there is a spread of the use of higher speed background stores.

Our cell-processor model was prepared from traditional circutts. In this one can see 16 cells on one printed card and each cell consists of two traditional units. Going beyond functional simulation, we did this in order to get real hardware

experience prior to construction of real cell processors. Since only the appearance of LSI (or VLSI) technology will create real possibilities for us (and development of this is still under way in Hungary) we are trying, until this appears, to design special processors with a cell-like organization using traditional parts which can be obtained commercially. We would like to mention one of the results achieved thus far, the picture-processing processor being prepared for a client in the GDR which does prefiltering and picture preprocessing.

Finally let me emphasize that from the viewpoint of the realizability of our plans the domestic appearance of LSI and VLSI technology is a key question.

So the big question is finally what can we realize here at home. In America, 9 months after his proposal, Professor Kung had a VLSI chip in his hand. It is true that "brute force" recommended weaker algorithms and cells--but they did it. We have an entirely new proposal, not heard of before, for bridging over this problem. There is a good chance that we could make VLSI's in the Hungarian style (by which I mean more precisely that there is no reason we could not) by using only existing technology. In this case, it seems possible to put several thousand microsize cells in one unit by the end of 1983. (To be continued)

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CRISIS IN SCIENTIFIC FIELD DESCRIBED

Olsztyn GAZETA OLSZTYNSKA in Polish 26-28 Jun 81 pp 1, 4

[Interview with Professors Wlodzimierz Baran, Zdzislaw Larski, and Stanislaw Szteyn by Czeslaw Wronkowski: "On the Status of Polish Science"]

[Text] In times of lively discussion of various topics, the role of science can in no way be ignored. As is known, science has not been standing apart, but has markedly influenced individual areas of the functioning of society. Its influence may not always have been positive, and in many cases it has actually been negative, but its creative nature must be perceived. It may be that it was not science itself but its representatives who caused harm to our economy. Thinking men are amazed by the large number of mistaken dicisions adopted on the basis of scientific and costly expertise acquired by scientists. It is hard to believe that such large numbers of educated people--and especially the highly trained people such as the scientific workers of higher schools and research institutions no doubt are--did not include brave enough or wise enough persons to warn the decisionmakers in time against mistaken decisions. Or perhaps their scientific awareness was so low as to prevent them from preceiving the consequences of their expertise? Or perhaps our [Polish] science is a pseudo-science and scientists are simply people who in most cases practice their hobbies at the state's expense?

What then is the state of Polish science compared with world science? What are the causes of the crisis of Polish science? What assures a scientist's success in research? I posed these and several other questions to eight professors at Olsztyn institutions of higher education. It is a pity that only three found the time to send me their answers to the above questions. These three are, however, individuals with undoubted scientific contributions and prestige, so that their comments can be approached with confidence and attention.

The professors who were kind enough to answer the above questions were: Wlodzimierz Baran (ART [Agricultural Technical Academy]), Zdzislaw Larski [ART, and Stanislaw Szteyn [WSP [Higher Pedagogical School]).

[Question: How do you assess the state of Polish science compared with world science? [The written responses follow:]

W. Baran: Such an assessment cannot be unambiguous. There are areas in which Polish science stands at the highest level in the world. Consider, e.g. the basic

research into stellar evolution by Polish astrophysicists. On the other hand, there are areas which never had--or had lost long ago--contact with world science and in which the distance separating them from the level of world science is growing instead of decreasing. This concerns chiefly all those domains in which advances are impossible without well-equipped laboratories and without research equipment. The lack of up-to-date equipment literally is paralyzing the development of the researchers based on the scientific experiment.

In satellite goedesy, e.g. unless observatories are equipped with latest-generation doppler receivers or laser rangefinders, it is not possibel to be an equal partner of the laboratories equipped with these facilities and thus to adopt their research programs. Obsolete equipment can be used only to solve problems marginal to a given discipline, most often those which the "haves" despise or disregard in their hurry to get on with more important research.

Z. Larski: This state is assessed as extremely low, even when compared with the state of science in the other CEMA countries.

S. Szteyn: The state of Polish science compared with world science is decidedly unsatisfactory. Only a few fields, such as certain branches of the natural sciences as well as of mathematics, physics, or archeology, are producing results that count on the world scale. The Polish engineering sciences decidedly lag behind the advances of world science.

Question: What are the causes of the crisis of Polish science?

W. Baran: The crisis which has affected all domains of our life, was also bound to affect science, which is one of the elements of the nation's socio-economic system. True, the consequences of this crisis, which began in the second half of the 1970's, were not as detrimental to the development of science as to that of various other branches of the national economy, but nevertheless it threatens the development of many scientific disciplines. A major cause of the crisis of our science is, in addition to the aforementioned lack of up-to-date equipment, in my opinion, the excessive bureaucratization of many organizational structures of Polish science.

A grave mistake, correction of which is being attempted at present, was the upsetting of the equilibrium between basic and applied research. Priority was given to the latter type, but nevertheless little was done to introduce the results of that research into production. Another cause of the crisis was the establishment of all kinds of research centers which resulted in the dispersal of effort and resources. Yet another and highly important cause of the difficulties being experienced by science at present has been, in my opinion, the moral crisis of the scientific community. A manifistation of that crisis is the disappearance of scientific criticism, the absence of objectivity in the assessment of research work, and also the not infrequently observed pursuit of "easy money."

Z. Larski: The principal cause of the crisis is seen in the fact that nonscientific considerations have influenced scientific progress ever since the founding of the Polish People's Republic. This resulted in giving preference to pseudo-social scientists and in effect often to pseudo-scientists as well. Such a situation has

resulted in a situation in which, apart from a few exceptions, the leading positions --including membership in the Polish Academy of Scinnces--were occupied by mediocrities. This in turn discouraged the others, including extremely talented persons, from getting ahead. What happened was negative selection.

Moreover, during the period of the drastic increase in student enrollment and concommitant decrease in quality of education, the recommendations for appointments to professorial posts often reflected not so much the suitability of the n minees as the need to adjust upward the number of professors to correspond with the rise in enrollment. This rapid quantitative increase, in its turn, served as the basis for granting to departmental councils the right to reduce the prerequisites for the satisfaction of degree requirements.

S. Szteyn: There are many causes of the crisis of Polish science. A major role here is played by economic considerations--the lack of funds for modern equipment, the problems with reagents, the limited contacts with world science, and recently even problems with the acquisition of foreign scientific periodicals. The initiation of truly innovatory scientific research always entails considerable financial risk. Given the current financial structure of [Polish] science (key problems, interministerial problems, etc.), scientists work on problems with regard to which they can be certain of performing their research on schedule. Thus there is nothing surprising in the fact that they deal chiefly with so-called "sure" topics, regarding which the risk is minimal. Definitely, too little attention is paid to--and hence also insufficient resources are allocated for--basic research and so-called noncontractual research. Scientists in this country are condemned to using equipment developed in other countries. It is only in those countries that true scientific progress is achieved, whereas we are condemned to a more or less modified duplication of that equipment. To put it in a nutshell, there can be no science without funds, and sizable funds at that. This is best evidenced by the share of scientists from various countries in the distribution of Nobel prizes. This is how I account for the fact that not a single Polish scientist--except for Maria Curie-Sklodowska, who had worked in France--has ever been awarded the Nobel prize in fields requiring substantial financial outlays such as medicine, natural sciences, physics, etc.

Question: How do you account for your scientific accomplishments?

W. Baran: My feeling is that what counts most for any scientist is human relations, in addition to the laboratory and research equipment. I was fortunate to be the member of a team in which an atmosphere of mutual goodwill always reigned, mobilizing all members of the team for work. It also mobilized me for work.

Z. Larski: In connection with what I stated before, persons lacking nonscientific patronage could achieve scientific accomplishments only by working so intensely that their families and health suffered. A major factor doubtless was talent, and sometimes luck as well; for example, the awarding of a stipend for study abroad which facilitates the discovery of talent and research opportunities.

Professor Szteyn did not answer this question.

Question: In your opinion, what predispositions are desirable for a young scinetist wishing to pursue a career in science? What personal traits assure his advancement in science?

W. Baran: To me, the principal desirable traits of young scientists are:

--industriousness and high self-discipline;

--passion for scientific truth;

--modesty and ability at intercourse with others.

Z. Larski: The young scientist should display: excellent memory, ability to analyze the observed effects and to classify and synthesize the observed facts; industriousness; strength of spirit, especially ability to withstand inevitable failures in scientific work; and knowledge of at least two foreign languages. These aspects are extensively discussed by H. Selye in his book, "Old Marzenia do Odkrycia Naukowego" ["From Dream to Scientific Discovery."]

S. Szteyn: What I prize most in young scientists is the spirit of independence which enables them to stop rigidly depending on the "master" in everything. I always regard my assistants as future independent scientists who must not only preserve, but also develop and refine, the knowledge inculcated by the instructor. Only scientists with these traits have the potential for making genuine scientific discoveries and advancing the state of knowledge. In Poland young scientists must be prepared to overcome many difficulties arising from our economic situation--difficulties that are alien to their foreign colleagues. They must also face the possibility that even if their scientific accomplishments are substantial, the resulting financial compensation will not be adequate to the effort invested.

Question: In your opinion, how can Polish science find a way out of this difficult situation?

W. Baran: The prime prerequisite for overcoming the crisis situation for science is the introduction of a far-reaching economic reform. In the meantime, everything must be done to avoid losing contact with world science. Halting the influx of professional literature from the Western countries could cause irreparable harm to Polish science. Attempts to end this influx have been undertaken recently.

One way of solving the crisis of Polish science should be to tighten the criteria for the employment and promotion of scientists. They should satisfy much higher requirements as regards training and moral attitude. The proper importance of scientific degrees and titles should be restored.

Z. Larski: Despite the nation's difficult situation, outlays [on science] should be sharply increased, overcoming the absurd conviction that science is a nonproductive branch of the national economy. In addition, it is necessary to drastically curtail university enrollment in many domains in which the economy's demand for specialists has been not only saturated but exceeded. This will enable scientists to devote themselves to research important to the economy.

Further, a reduction in the numbers of university students, many of whom are by now potential jobless university graduates, will slow down the race of appointments to professorial posts. One way of solving the crisis of our science is to disband the bureaucratic institute structure imposed after 1968. This structure has in no way

benefited science, and is heavily weighted in favor of the administration. For example, in our Department of Veterinary Medicine 12 out of 16 independent scientific workers occupy administrative positions: 1 dean, 2 deputy deans, 3 directors, and 6 vice directors. Also improperly termed cooperation between higher educational institutions and the national economy needs to be revised and altered.

S. Szteyn: I do not foresee any rapid solution of the crisis of Polish science. As this nation's economic situation improves, increasingly greater funds should be allotted to science. Contact with world scinnces should be also made possible quite rapidly--and that not only through unrestricted access to world literature but also through personal contacts. In addition, scientists should be given a free hand in the selection of research topics, and the occasional lack of results should be regarded as a natural risk of scientific research. Further, Polish science should be debureaucratized.

Also, the "manipulation" of scientific degrees and titles should be eliminated. This should restore appropriate rank to scientists in this country. Hence the crisis of Polish science should be solved not only on the material, but also on the moral plane.

Questioner: Thank you for your comments, some of which are extremely critical, but honest. This is what our readers expect from men of science.

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BRIEFS

NEW MINICOMPUTER--A new type of computer of the "M-118" family has been produced by the Enterprise for Electronic Computers in Bucharest, according to designs of Romanian specialists. Presented recently at the Leipzig International Fair, the Romanian minicomputer, the "M-118-GS," was highly evaluated by specialists and was awarded the Fair Gold Medal by the organizers. From the technological point of view, the "M-118-GS" minicomputer is far superior to other products of this type manufactured in Romania or abroad. The system includes new equipment, with a device for the graphic and alphanumeric display of data on a television screen, which ensures a perfect presentation of the results of the computations both in numerical form and in the form of graphs and tables. Its performances rank it among the minicomputers with average to large capacity and it has numerous useful programs in fields such as: scientific research and engineering technology, in design, education and administration. Its functional and construction characteristics allow customers to install it and utilize it with facility under any conditions. [Text] [Bucharest SCINTEIA TINERETULUI in Romanian 10 Jul 81 p 1]

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